Power Plant ENGINEERING

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THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

JANUARY • 1945

Features

SHAPE OF POWER ENGINEERING TO COME • CONTACTORS AND CIRCUIT BREAKERS AS SWITCHES • DUNN SULPHITE PAPER COMPANY PLANT • CENTRIFUGAL PUMP CONTROL • DATA ON MODERN EXTRACTION TURBINES • CONTINUOUS BLOWDOWN ON BOILERS

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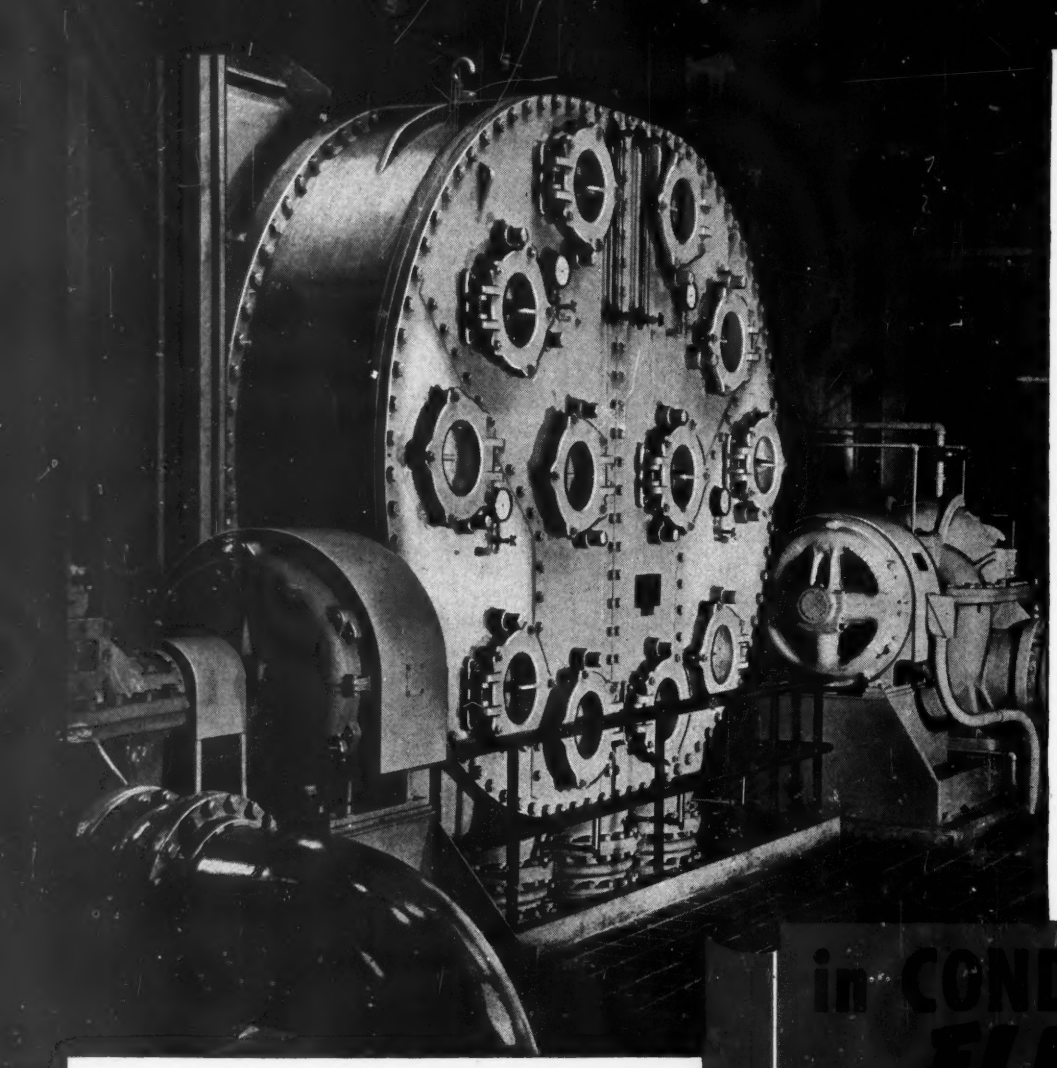

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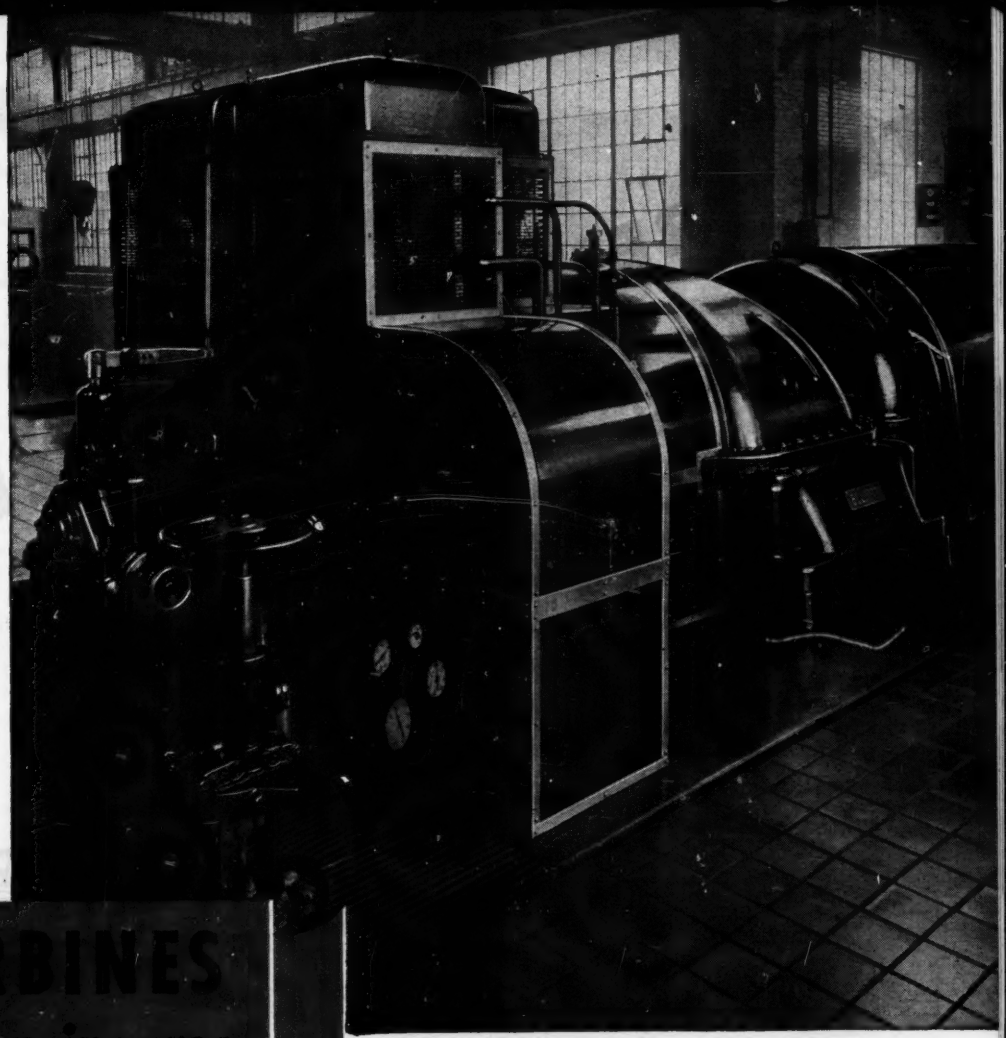

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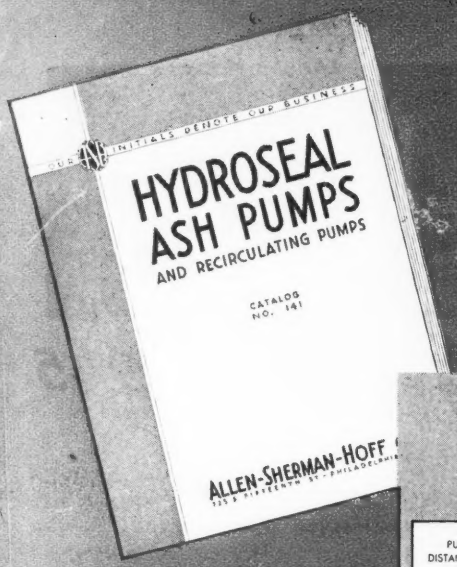
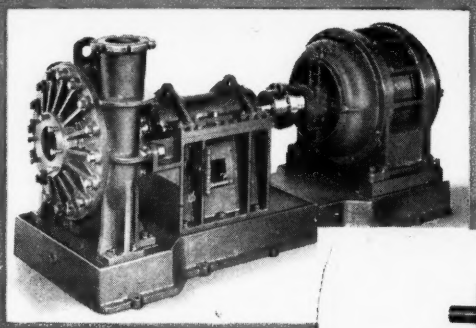
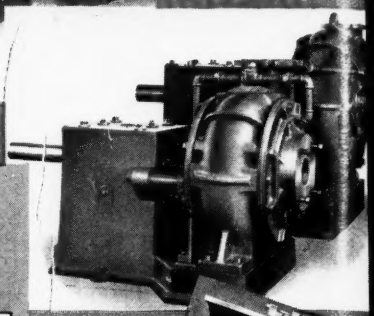


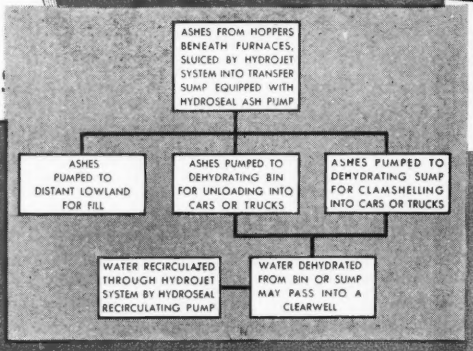


Hydroseal Recirculating Pump

Hydroseal Ash Pumps



Ashcolite Pipe used with Hydraulic Ash Handling


ASHES FROM HOPPERS BENEATH FURNACES, SLUICED BY HYDROJET SYSTEM INTO TRANSFER SUMP EQUIPPED WITH HYDROSEAL ASH PUMP
ASHES PUMPED TO DISTANT LOWLAND FOR FILL
ASHES PUMPED TO DEHYDRATING BIN FOR UNLOADING INTO CARS OR TRUCKS
ASHES PUMPED TO DEHYDRATING SUMP FOR CLAMSHELLING INTO CARS OR TRUCKS
WATER RECIRCULATED THROUGH HYDROJET SYSTEM BY HYDROSEAL RECIRCULATING PUMP
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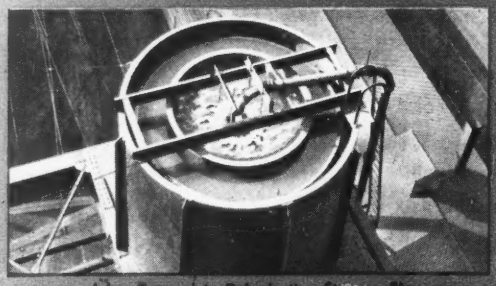
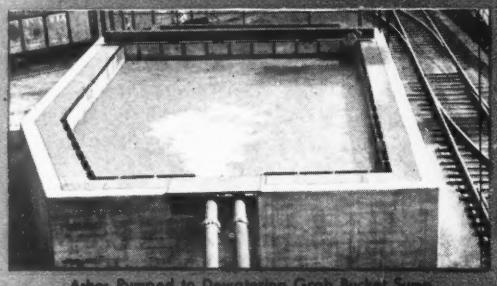
Pumping Ashes to Distant Fill



Ashes Pumped to Dehydrating Storage Bin



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FRONT LINES

ROCKET POWER is already a big business. With the Navy spending $100,000,000 a month for rockets, the Army asking for an appropriation of $150,000,000 for them, and millions being spent in the development of jet propulsion engines and airplanes, we can no longer look upon rocket power as a dream for the future. It is already a big business, the Harvard Engineering Society and the Harvard Club of New York were told recently by G. Edward Pendray, assistant to the president of the Westinghouse Electric & Mfg. Co. and secretary of the American Rocket Society. "New post-war industries will spring from this enormous wartime development of rockets, rocket motors, jet propulsion engines and gas turbines," Mr. Pendray said. "The size of the new industries will depend largely on the progress our engineers and scientists are able to make during the remainder of the war. The effect on us, as civilians, will be enormous. Jet propulsion and rocket power will provide new altitudes and new velocities for flight, new power for aircraft, and new devices as important and revolutionary to human life as the invention of the airplane itself."

FOR A LONG TIME we have been pondering the curious and inexplicable fact that, in this country at least, many of our attitudes are exactly the opposite of our actions. Leo M. Cherne has given forceful expression to this, as noted in October Front Lines. But a number of readers have asked just what this remark means. Well, here are some examples. Politics is a dirty business and a decent man won't soil himself with it. Ask anybody and he'll tell you that. In the same breath, he'll add that what we need is more good men in politics. One of the greatest evils of our time is the intense nationalism and isolationism of every country under the sun. Everybody says so, points out that we must be internationally minded and brands an isolationist as almost a traitor. Yet the word international means between or among *nations*. And each nation will tell you that it is fighting this war to preserve its *national* freedom or to gain same. International cartels in business are wrong, we all say, yet they are the strongest force in business today. Germany is planning to win the peace with them, controlled by an underground Nazi clique. All the great nations of the world advance trade by their use and they are actually on the increase. Yet everybody says they are wrong and should not be. So it goes: newspapers misrepresent and poison public opinion, we say, yet we continue to pay four cents a copy for one or two of them each day. We have the highest respect for organized religion, we allege, yet the great bulk of us never go to church, except at Easter. Why this incredible contrast between what we say and what we do? It's one of the most important factors to reckon with in dealing with human beings—including ourselves.

TANTALUM is being used in many unusual ways. This metal is not irritating to living tissues, is ductile, malleable and resists corrosion. Wire so fine that a surgeon feels for it rather than sees it is now being used to repair nerves and to make surgical stitches where facial appearance is important, according to Ohmite News.

LOW-COST and special defense housing construction has invited the use of chimneys that are much lighter, less expensive and less permanent than the conventional brick construction. The National Bureau of Standards has made some tests of such chimneys. To aid in establishing performance requirements, the Bureau has tested a lined and unlined brick chimney, with a floor construction representative of details in dwellings. It was found that the unlined chimney created a hazardous condition in the surrounding woodwork with a continued flue-gas temperature of 900 F and the lined chimney with a flue-gas temperature of 1100 F. However, this condition did not obtain for the lined chimney until after 13 hr and a slightly shorter period for the unlined chimney. A number of firing tests were conducted with heating equipment known to give high flue-gas temperatures. Results of all the above tests should be of value in designing all post-war housing. There is a tremendous stored-up demand in this country for housing and without question some of it will be met with the worst kind of jerry-building, in order to meet the demand quickly and at the same time cash in on it. Yet even if you try to build a house out of old packing crates, the Bureau's chimney data should help design the chimney so it won't set the crates on fire.

THE FIRST serious attempt to study industrial relations objectively and in a truly scholarly way will be made in a new Industrial Relations Center being established at the University of Chicago. Here university-wide service will be provided for management executives, labor leaders, Government officials, faculty and students, integrating and expanding the work touching on industrial relations that has been in progress in the various departments of the university.

GERMAN STEEL PLANTS, largest producers in Europe before the war and second only to the United States in world production, have been the backbone of Germany's war machine in both World Wars, says the American Iron & Steel Institute. Steel production in Germany and the Saar, for which we are now fighting as this is written, was nearly tripled from 1933 to 1937 by using existing capacity to the full to build up armaments. At the crest of German power, with the steel capacity of satellite and conquered nations integrated into the scheme, almost 60,000,000 tons of steel capacity was available to Axis Europe, about half of that in Germany proper. Today the total may have decreased to about 36,000,000 tons. These facts underline the importance to our post-war policy makers of studying carefully the recent program suggested jointly by the presidents of ASCE, AIM & ME, ASME, AIEE and AICE for controlling Germany after the war. Briefly, this program calls for elimination in Germany of: 1, all synthetic oil capacity; 2, 75 per cent of synthetic nitrogen capacity; 3, 50 per cent of steel capacity; 4, all aircraft plants and equipment. These would be accompanied by restrictions on construction of new plants and careful supervision of imports of oil, nitrates, iron or steel, aluminum, and magnesium so that only enough could be obtained for legitimate peaceful purposes. If any one of these steps were taken, it is very doubtful if Germany could prepare for war or wage it. If all four were taken, that should be ample insurance. When our policy-makers finally catch up with the engineers, they may be able to figure out how to keep Germany under control.

BUT—is everybody going to want a new house after the war, even though he isn't going to be able to get it? For one thing, until the housing industry gets its prices down to the point where families with average yearly incomes of $1800 or less can buy something besides a flimsy shack built of cardboard for less than $5000 or $6000, we know a lot of people who are going to tell the building industry to go fly its kite in a telephone booth. Why should a man tie himself up with 20 years of installment payments on a house thrown together out of surplus war material? His job may evaporate and besides, he's been working the graveyard shift in a war plant for two years and he's tired of looking at the inside of that factory. He wants to move around a bit. Why not put his few hundred dollars into a trailer and live in that? Then there are the thousands of ex-servicemen who will have an itching foot after this war. That has always been one of the characteristics of war. We remember well an ex-navy friend who bought a second-hand 5-ton truck and lived in it all over the country for two years, until he was caught and house-broken by a handsome red-headed girl out in Colorado. A very interesting address on this subject of the Age of the Itching Foot was given recently before a youth group in Chicago by Father Daniel A. Lord, S. J. "The lads who have lived in this highly technical war can't help but get an exaggerated idea of mechanical achievement," he said. "They're going to expect to be a nation of button pressers and travelers. It will be a cock-eyed period but I think it will be only a phase." The good will just about offset the bad, Father Lord believes. The urge to travel and get away from old ties will result, he thinks, in a strong decentralization movement from great cities to small country towns and to farms. So there's bound to be a great deal of moving around for a while after the war, for the American civilian population, too, has been without its customary travel jag for about three years. The minute cars and gasoline are available again, the whole nation will be on the move to look over its own country and "get away from it all." What will all that do to the demand for housing? And for domestic electric appliances and heating equipment and all the things that people who live in houses have to buy? What, if anything, will it do to the power industry?

A POSTWAR FEDERAL TAX PLAN for High Employment, proposed by The Research Committee of the Committee for Economic Development has been published in the form of a 48-page booklet available from the CED, 285 Madison Ave., New York 17.

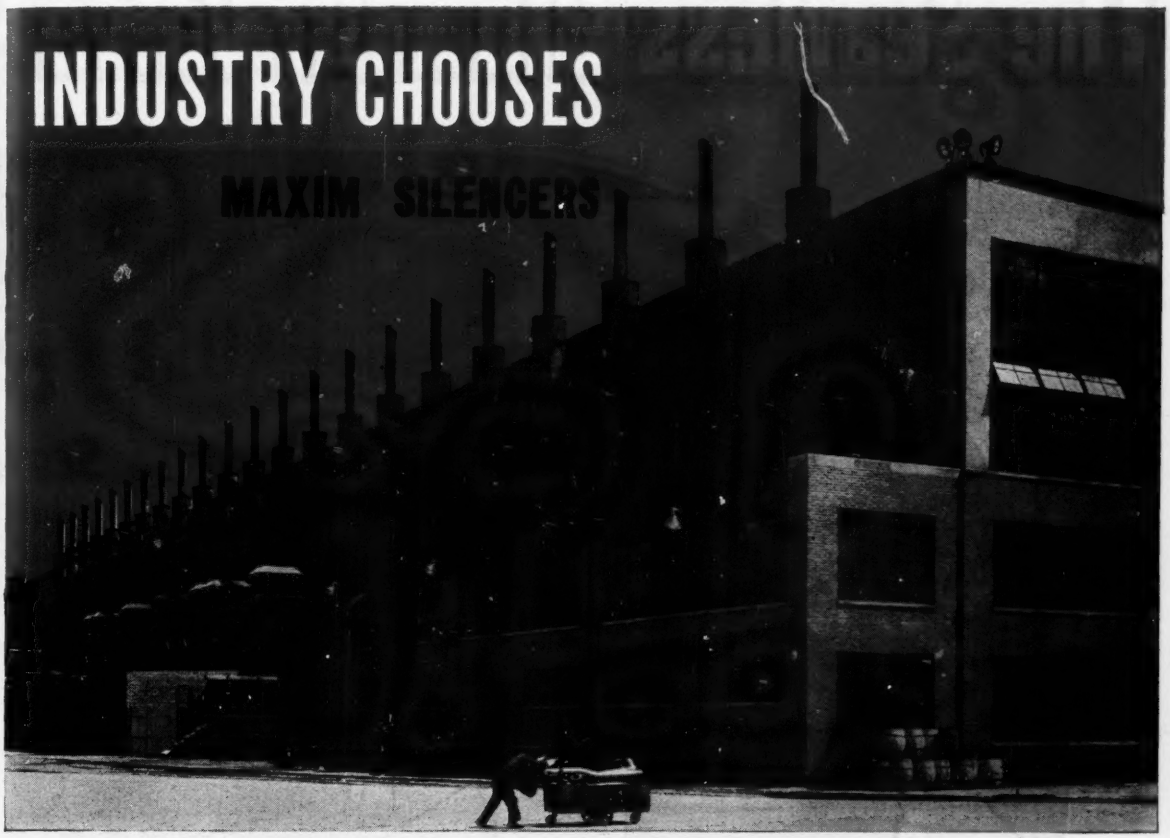
BECAUSE THEY KNOW how fathers like to play with electric trains, a number of steel companies have turned to using working models of cranes and steel mill equipment to teach employees the fundamentals of safety, the American Iron and Steel Institute reports. To their surprise, they have found that women, too, enjoy "playing" with the models as they learn. One steel company has a model crane equipped with every type of safety feature, including fire extinguishers, warning signs and safety guards. It is constructed of movable parts and has a real magnet which will pick up weights of approximately 500 lb and will do almost anything a big crane will do. The model crane is equipped with a limit stop and with regulation controls. It is used in training classes so that new operators can learn how to handle loads with the fewest number of movements. More important, the operator will learn how to avoid taking chances which might result in injury to the workmen on the floor below.

REFERENCES to the possibility of starvation—literally lack of enough food in this country—have been made, says Alan Devoe in the American Mercury, by various prophets. If the smooth, familiar machinery of bottles and tins collapses, is there then nothing to eat? Absurd. We should be under no more dire necessity than to revive our skill and application as natural animals. The earth remains. Every wild hedgerow, copse, and clearing teems with good edibles. We have just neglected them. Take away the technology and the raw materials remain. There are enough leaves and nuts and roots and pods and berries to keep us sleek as woodchucks. Tea? Make it from goldenrod; the Chinese used to import our goldenrod for this purpose. Salads? The famous German rampion is nothing but our own wild evening primrose transplanted to Germany. Locust tree seeds were used for years in the manner of peas and beans. Acorns of the white oak, when boiled, make a cake that sustained the Iroquois. Asparagus seeds? They make a good coffee. Chickweed is better than spinach. Jack-in-the-pulpit was the Indians' native turnip. Of milkweed the Plattes made sugar. Lupine seeds are peas, early blue violets a kind of wild okra. To say nothing of our stores of fruit, fish and game. True, the denizens of New York and Chicago would have to forage for food outside their steel and concrete cubicles. (But would that hurt them much?) Unless we are unable to summon as much animal proficiency as a chipmunk, as much woods-wit as a coon, we are hardly lost, says Mr. Devoe. We have only to get down to earth.

CARBORUSTEX, a powerful new solvent for rust, has an affinity for rust itself, but will not attack the unoxidized metal, according to the manufacturer, Carbozite Corp. CarboRustex is composed of several different chemicals, each of which has its individual reaction upon the various conditions of rusted surfaces. One of these chemicals assists in dispersing the active ingredients uniformly over the surface. Others chiefly attack any grease or oil that may be present so that the other active chemicals can come directly in contact with the rust. Most of the ingredients are very slow in evaporation so that the surface will stay moist for a long time, which permits the active ingredients to react for the maximum length of time. None of the chemicals in CarboRustex are toxic nor are they injurious to the skin. The solvent is non-inflammable. It is applied by the brush, spray or dip method, spreads readily and leaves no globules. A sufficient quantity of a chemical rust inhibitor, which is dissolved in water, is furnished to rinse the metal surface after the rust has been removed. The rust inhibitor will protect the surface from oxidation for several days or until the surface can be permanently protected with a protective coating.

A NEW TRANSMISSION PHOTOMETER for measuring accurately the amount of light transmitted through very small areas of spectrographic plates, has been announced by the Special Products Division of the General Electric Co. The new photometer is desirable for use wherever spectrographic analysis is employed, such as in the metal fields, and also for microcolorimetric and microchemical analyses and for measuring light transmission through solutions. Requiring a constant power supply of 6 v, a-c or d-c, with an approximate capacity of 30 amp, the photometer consists essentially of a light source, an optical system, a galvanometer, a light-sensitive cell, and a mechanical stage for accommodating the plate.

INDUSTRY CHOOSES MAXIM SILENCERS



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Maxim, conservatively the greatest name in silencing, has become so because of many years of research and practical experience in this field. Today's Maxim Silencers give users the advantage of this greater experience in development and manufacture of silencing equipment.

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Maxim Heat Recovery Silencers make use of engine exhaust heat, normally wasted, to produce steam or hot water for heating or processing operations. This is done without the use of any *extra* fuel except that normally used in engine operation. Send for Maxim Heat Recovery Silencer Bulletins WH-100, WH-101, WH-102, WH-103.

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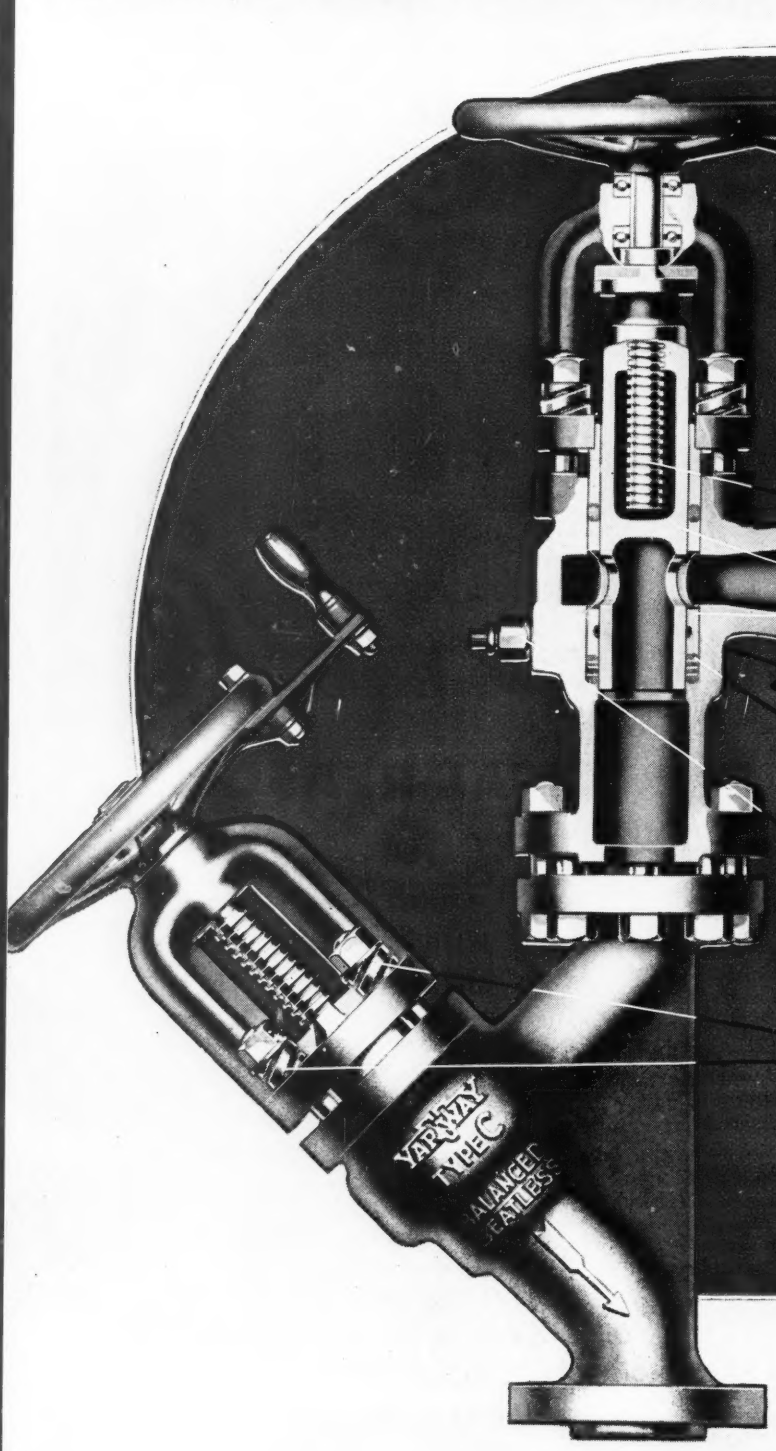
The Seatless Blow Off Valve



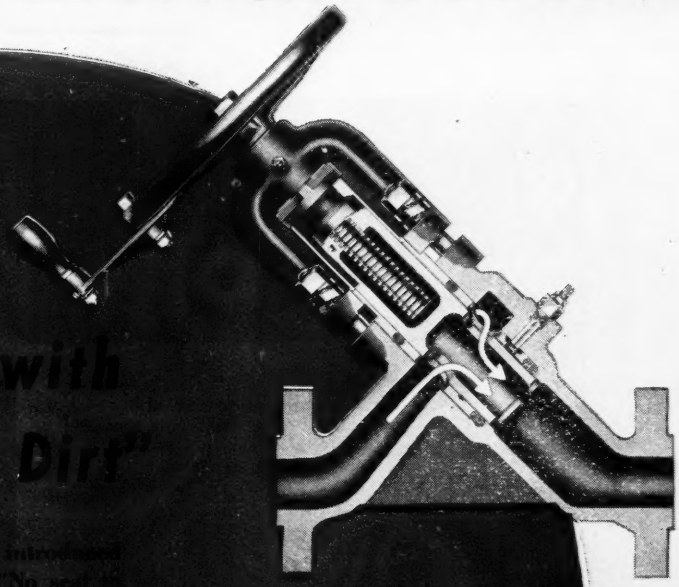
BECAUSE ★ ★

"No Seat to Score"

Yarway Type C Seatless Tandem Blow-Off Valve (angle valve Fig. 3910, straightway valve Fig. 3912) for pressures up to 600 lbs.

YARWAY

"Standard" in Over 12,000 Plants



Wear and Clog with Mud, Scale and Dirt"

More than a quarter century ago, Yarway introduced their Seatless Blow-Off Valve and said—"No seat to score, wear and clog with mud, scale and dirt." Power plant operators, harassed by continuous trouble and expense with conventional valves—welcomed the Yarway as the answer to their troubles . . . purchased them, watched them, standardized upon them. And the Yarway Seatless design, in a relatively short time became the most widely preferred blow-off valve.

Today, after a quarter century of service, it still holds that distinction. Sound fundamental design . . . coupled with continuous mechanical and metallurgical research anticipating ever-new service requirements . . . makes the latest improved Yarway Seatless Valve of today just as good insurance against Blow-down trouble and expense in today's plants as it was in the plants of twenty-five years ago.

There is a Yarway Valve for every pressure and purpose. Write for Catalog B-424 for pressures up to 600 lbs. Catalog B-431 for higher pressures.

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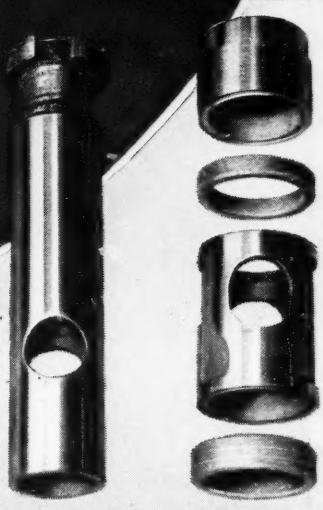


Nitralloy Plunger and lower Follower Gland, and laminated packing with stainless steel inserts, add years to valve life.

BLOW-OFF VALVES

How to restore the efficienc

Six years without a forced shutdown is a common occurrence for boilers operating under Hall System. Periodic inspection of your boilers by the Hall field service engineer helps detect any danger signals that indicate boiler troubles in the making. Guiding him in this important work is not only his own experience but the combined knowledge of the technical staff of Hall Laboratories, Inc.

of *below par* boilers

FROM the moment a boiler is put on the line, forces go to work to impair its efficiency. With the least letup in vigilance, scale, corrosion, carryover and embrittlement get right down to their dirty work.

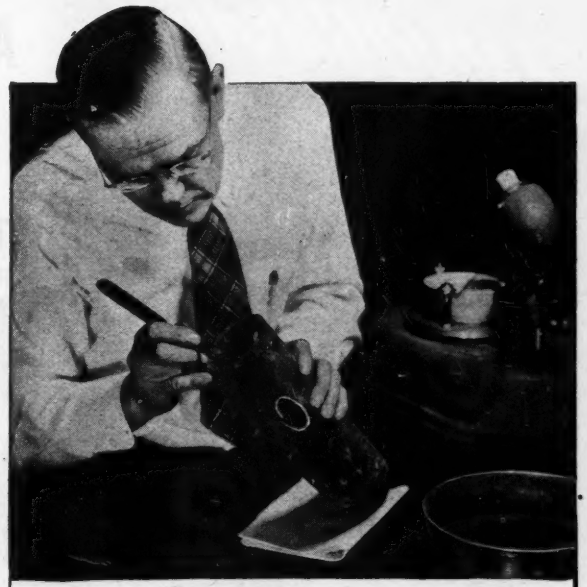
Here is what happened to an unwary manufacturer just when the demand for his products was greatest—

> "We have been through a lot of trouble with our boilers and finally had to put in all new tubes. I am certain that had we had proper water treatment all along, this trouble would not have occurred.
>
> "Will you please arrange to have the nearest Hall Laboratory representative call on us and take over the feed water treatment of our boilers?"

A Hall representative called at the plant. He obtained a sample of the scale and sent it to the home office. Chemical analysis showed that it was composed of calcium carbonate, calcium sulphate and calcium silicate. This clearly indicated that proper conditions had not been maintained in the boiler water—otherwise the scale would not have formed.

Methods of maintaining proper conditions in the boiler water by the use of phosphate, alkali and tannin were established. This stopped scale formation, maintained necessary alkalinity and provided sludge dispersion properties necessary for fire-tube boilers.

This is a typical example of how Hall System brings back the efficiency of under par boilers. Daily reports from the plant personnel and periodic check-up by the Hall field service engineer provide the information needed to keep boilers producing at top efficiency. Let us tell you more about what Hall System can do for you.



Scale, even of paper thinness, is dangerous when boilers are being pushed to the limit. Hall Service determines the basic cause of scale and recommends the steps for correction.

Embrittlement makes tough steel fail. Hall Service determines whether or not boiler water is of an embrittling nature and suggests the remedy.

HALL LABORATORIES · HAGAN BUILDING · PITTSBURGH 30, PA.

A Subsidiary of Hagan Corporation

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM *of Boiler Water Conditioning*

Hall Service in a Nutshell

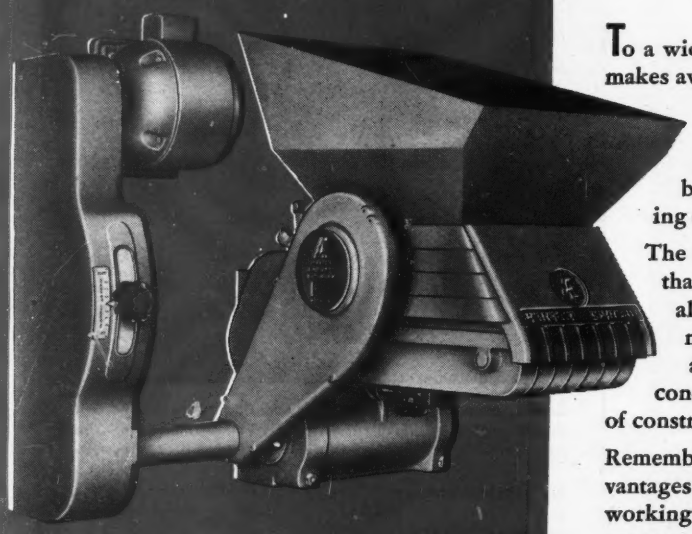
At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. **Minimizes boiler outages caused by water.**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water.**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

ANNOUNCING

THE

Æ PERFECT SPREAD STOKER



To a wider group of steam producers, Æ now makes available a modern, completely automatic stoker that is up-to-the-minute in every feature. It's the Æ Perfect Spread Stoker taking its "streamlined" bow—backed by 38 full years of *stoker* engineering experience in the large power plant field.

The Perfect Spread Stoker eliminates tasks that spell boiler room drudgery. It burns all kinds and grades of solid fuel with maximum efficiency. And it owes unusually quiet, reliable operation to a new conception of stoker design and simplicity of construction.

Remember these time- and money-saving advantages when thinking of your own boiler room, working conditions, steam costs, and operating expenses. By all means, write now for the new bulletin that tells you how to produce more steam at lower cost... with the Æ Perfect Spread Stoker.

FEATURES TUNED TO THE FUTURE

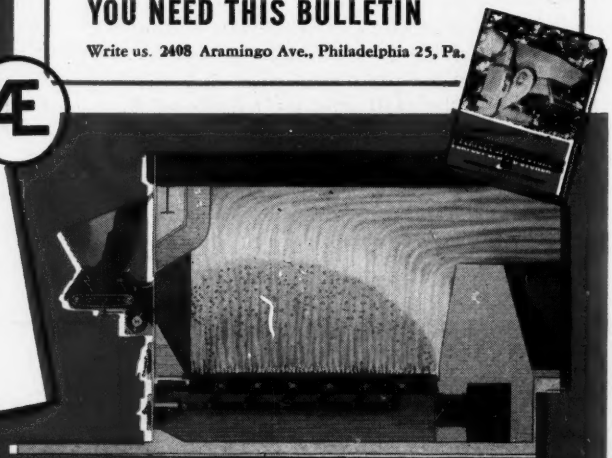
- Improved Streamlined Design
- Completely Automatic—Amazingly Quiet
- Burns wide rang of Solid Fuels
- Fully Protect d, Accessible Mechanism
- Non-Clog Saf ty Feature
- Water Cooling at Vital Points
- Exclusive "Cross-Firing" Grate Design
- Easily Installed
- Low Initial and Operating Costs

. . . and more

IF YOUR Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.



Æ

Æ PERFECT SPREAD STOKER

Other Æ Products: Taylor Stokers, La-Bel Hoists, Marine Hoist Automatic, Roto-Grate Fuel Feeder, Diamond Fuel Breakers

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PA.

ANNOUNCING....

THE IMPROVED

Æ TAYLOR STOKER

TYPE "R"

It is probably no news to you that many hundreds of the Nation's boilers are fired by Taylor Stokers. Or that the record of Taylor Stokers is one of highly efficient, reliable steam generation for the past 38 years.

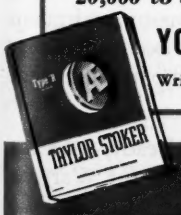
But now . . . sweeping improvements . . . long in preparation . . . have been combined to add *new* efficiency to time-tested Taylor Stoker principles. Simplification is the keynote. Simplified construction, installation, operation and maintenance mean more thorough combustion, less frequent outages, at a lower net cost.

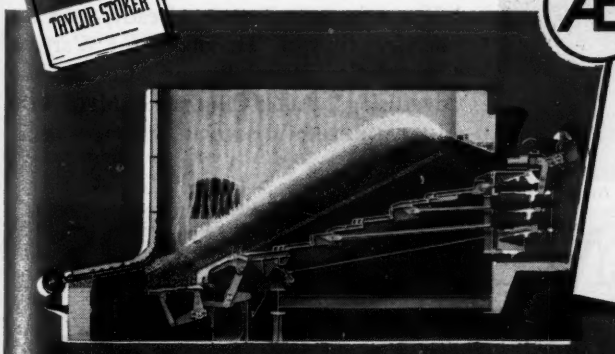
These valuable new features and their direct advantages may have an important bearing on your future operations. Arm yourself *now* with the facts that will help make your decision on stoker equipment 100% right. Send today for the new Type "R" Taylor Stoker booklet.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

Write us. 2408 Aramingo Avenue, Philadelphia 25, Pa.





OUTSTANDING *FEATURES* OF THIS *IMPROVED* TIME-TESTED STOKER

- Simplified Construction Throughout
- A Completely Self-Contained, Self-Supporting Unit
- Easily Installed
- Fewer Moving, Longer Wearing Parts
- Precision Control Feed Mechanism
- Unique Hydraulic Drive Continuous Ash Discharge with Automatic Timing
- "Finger-Tip" Action Steam Power Dump
- Air-Operated Clean-Out Dampers
- Better Air Flow—More Thorough Combustion
- Minimum Stack Discharge
- Quick Firing—Adequate Reserve Capacity
- Available in Air or Water Cooled Design
- Air Cooled—Easily Converted to Water Cooled
- Burns Wide Range of Coals

Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PA.

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make SHAFTS Last Longer . . .

The Allis-Chalmers "Electrifugal" Pump is a unit-designed pump . . . with both impeller and motor mounted on one shaft and in one frame. The next time you need new pumps . . . look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps . . . the "Electrifugal" . . . and all types for every purpose.

WHERE YOU HAVE an Allis-Chalmers "Electrifugal" Pump . . . shaft and rotor pictured at left . . . you don't have an alignment problem—because *both* impeller and rotor are mounted on *one* shaft.

However, many pumps in use today are coupled to a separate motor, and how well the two are aligned has a lot to do with how long the shaft lasts . . . and the pump and coupling too . . . because misalignment starts all three fighting each other!

Here are a few tips which will help you get longer life out of pump shafts:

▶ See that pump and motor coupling flanges are parallel . . . both vertically and axially . . . and that they are kept that way!

▶ If misalignment recurs frequently, check foundations, piping, bolted connections.

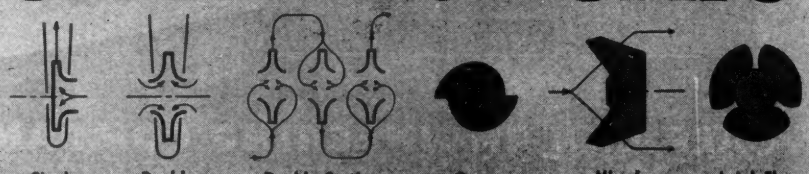
▶ In the case of boiler feed or other pumps which reach high operating temperatures, be sure that alignment of motor and pump is checked after *both* have been operating. Otherwise they might develop misalignment from unequal expansion.

▶ If you haven't done so already, send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". Contains *no* advertising. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN. A 1707

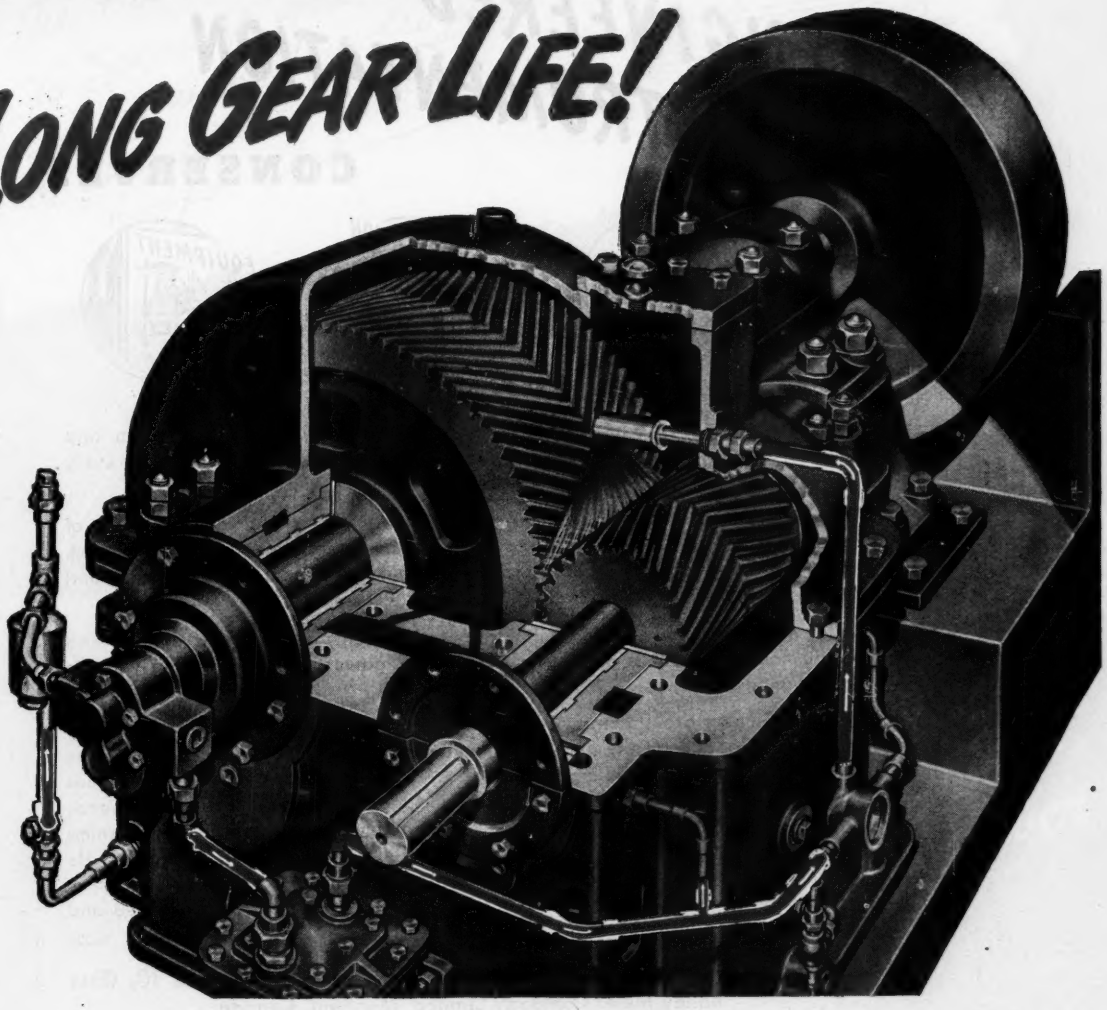
Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



Get This Protection for LONG GEAR LIFE!



WHEN tooth meets tooth in high-speed gear sets, as above, it takes a strong oil film to fight friction that absorbs power and causes wear.

Moreover, because the whirling gears churn oil and air together, this same oil must possess great chemical stability to resist oxidation and remain free from sludge.

Gargoyle Vacuoline Oils combine these properties and have proved ideal for circulation and splash-oiled gear sets. Their strong films protect against metal to metal contact, *reduce wear*, assure *smooth, silent gear operation*. Their stability means long oil life as well as long gear life.

For exceptionally heavy-duty service, where tooth pressures are unusually high, Socony-Vacuum prescribes its Gargoyle Compounds. These special lubricants form films that bond to the metal, prevent destruction of heavily loaded gear teeth.

Ask your Socony-Vacuum representative for recommendations on the best protection you can buy for your gears.

SOCONY-VACUUM OIL CO., INC.
Standard Oil of N. Y. Div. · White Star Div. · Lubrite Div. · Chicago Div. · White Eagle Div. · Wadhams Div. · Magnolia Petroleum Co. · General Petroleum Corporation of California.

CALL IN SOCONY-VACUUM FOR "CORRECT LUBRICATION"

Socony-Vacuum's FIVE STEPS to Lower Production Costs for You

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured

GARGOYLE Lubricants

DETROIT PUBLIC LIBRARY

ENGINEERED INSTRUMENTATION

CONSERVES

★ To be truly effective in the conservation of fuel, manpower, transportation, and major equipment, boiler room meters and control systems must be carefully engineered to the particular requirements of the plants which they serve.

Thorough instrumentation engineering starts with a careful consideration of improvements which may be effected; and continues through with the application, design, construction, calibration, installation and adjustment of the meters and controls necessary to secure these desired improvements.

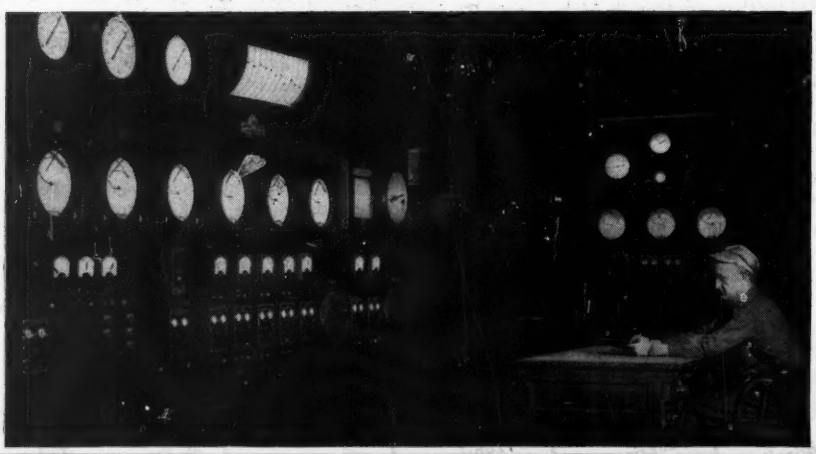
Bailey Meter Company, through its staff of thoroughly trained and experienced combustion engineers is helping power plant engineers to achieve their wartime conservation objectives.

Bailey Engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense. The Bailey Engineer in your community has a vast store of data at his command which includes results from tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that he has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation together with the other benefits which result from intelligent use of correctly selected and properly applied instrumentation.

G-22-1

BAILEY METER COMPANY • 1040 Ivanhoe Road • Cleveland 10, Ohio

Bailey Meter Company Limited, Montreal, Canada



Bailey Boiler Control at the Wyandotte, Michigan Plant of Wyandotte Chemicals Corporation

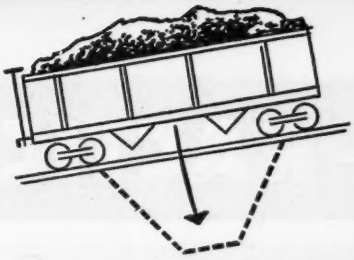
BAILEY METER CONTROL

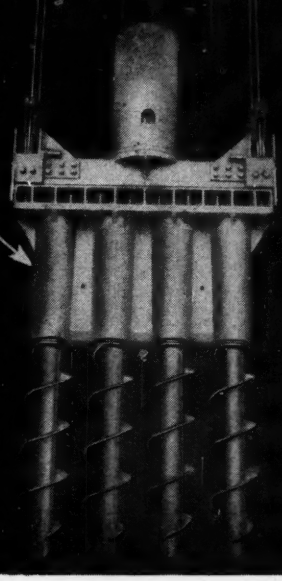
BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

BAILEY METERS

The Complete Combustion Control System

The Problem — To Speed up and reduce cost of unloading frozen or wet, fine coal from hopper cars —





This "MATERIAL ACCELERATOR" is the **S-A** *Answer*

• In addition to systems designed to solve the more general problems of conveying and elevating coal, S-A has equipment developed to meet special or unusual needs.

The S-A Material Accelerator shown here, is a case in point. With this unit, frozen coal or fine wet coal—always a major problem—can be unloaded much more rapidly than with previous methods (2 to 3 times as fast in a typical case on record).

Here's how it works: The screws of the Material Accelerator are lowered into the frozen or wet coal. After penetration to the full depth, screws are reversed, pushing the coal downward. The whole unit is moved back and forth on an overhead crane bridge on which the hoisting mechanism is mounted.

For full details on the Material Accelerator write us today.

STEPHEN S-A DAMSON
MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

PRACTICAL PLANS for

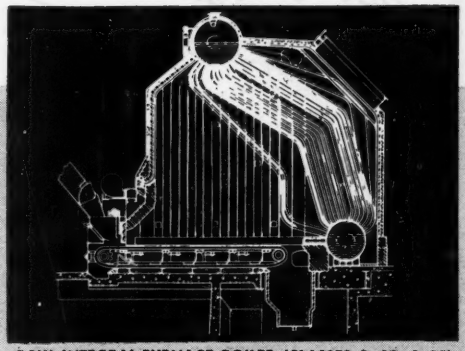
In the wake of this war will come new jobs for steam . . . new opportunities . . new problems . . . keener competition . . . that will put renewed emphasis on power plant reliability, efficiency, and operating costs.

When the urgency of war production begins to unwind into the pattern of peacetime competition, power plant engineers will want to be ready in advance with step-by-step plans for urgently needed modernization and expansion of existing facilities. Properly drawn, such plans will help speed reconversion of their own industries and hasten action in providing for fully integrated power services having the high overall efficiency, and flexibility for changing conditions that future operations will demand.

War effort still must continue to have first call on present power plants and power men. Yet it is not too early now to be looking forward in constructive thought . . . planning tomorrow's action . . . scanning present horizons for the best means to translate today's plans into tomorrow's needs.

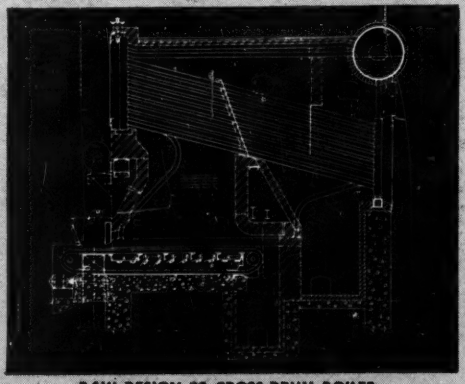
Thinking and planning for tomorrow *today* is a job B&W engineers are ready to tackle in partnership with power engineers of industry. Their long leadership in meeting steam power requirements has been greatly augmented by much more valuable experience gained in serving the industry war needs.

When the time comes to specify equipment for the future, there is a B&W boiler for any combination of conditions . . . capacity, pressure, temperature, feed-water, fuel and space . . . to be met. Whatever the type needed, it is built for the job, thus assuring the highest standards of performance, continuity of service, high overall station economy and greatest return on the investment.



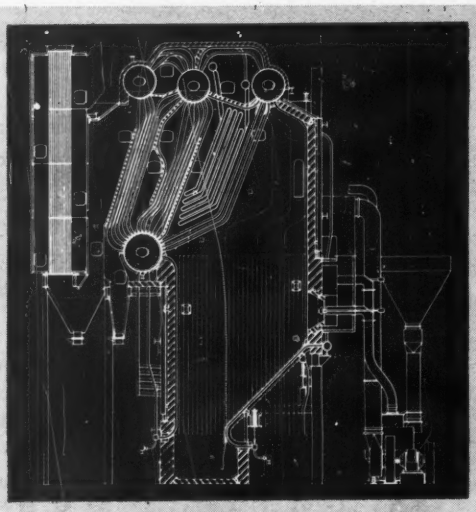
B&W INTEGRAL-FURNACE BOILER (CLASSES 9, 12, & 15)

This Integral-Furnace Boiler is available for firing with stokers or with oil, and in sizes ranging from 3353 to 6506 sq. ft. of heating surface. Having a water-cooled furnace of special design, this boiler provides the dependability of central-station boilers, with efficient and smokeless combustion.



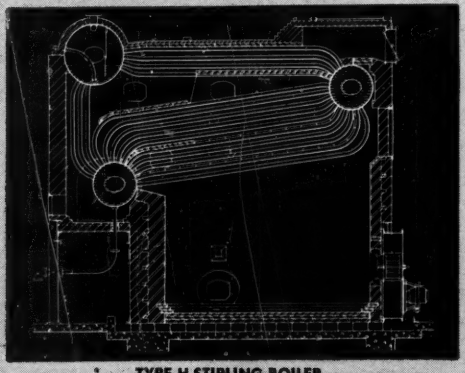
B&W DESIGN 32 CROSS-DRUM BOILER

This unit is widely used in small and medium-size power plants where refractory furnaces are suitable. It provides the advantages of the straight-tube, sectional-header construction used in B&W Cross-Drum Boilers designed for larger capacities.



STIRLING BOILER

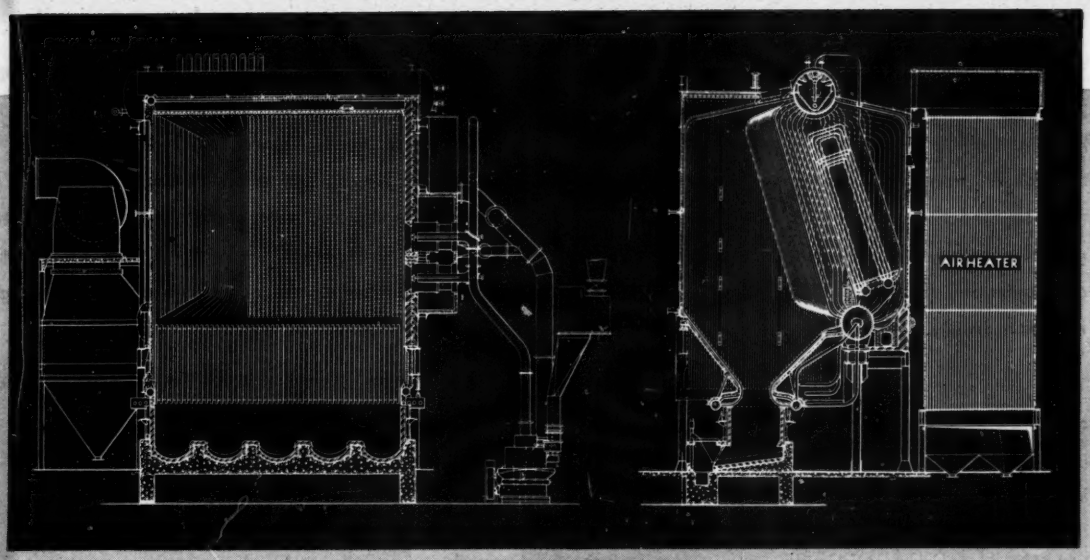
The Stirling Boiler fully meets the requirements of modern operating conditions. It readily responds to sudden and heavy demands for steam, and delivers dry steam at relatively high ratings when operated with water having a high concentration of solids. May be fired with any fuel.



TYPE H STIRLING BOILER

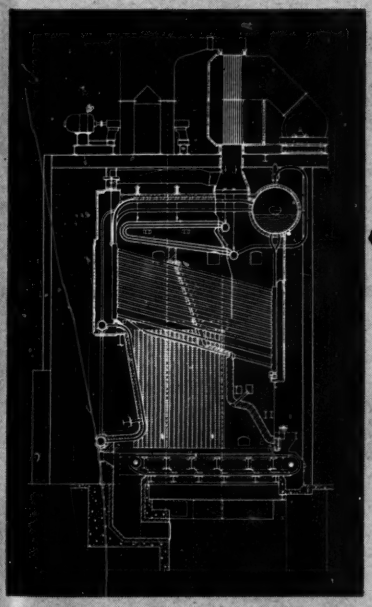
A low-head moderate-pressure unit that is widely used in small industrial plants, institutions, hotels, office buildings and to meet other similar requirements. Available in capacities ranging from 1500 to 30,000 lb. steam per hr. and for firing with any fuel. The furnace, usually of refractory, provides the necessary degree of dependability.

PEACETIME POWER . . .



INTEGRAL-FURNACE BOILER

The Integral-Furnace Boiler is a completely co-ordinated unit built in capacities up to 250,000 lb. steam per hr. and for the pressures and temperatures required by the most up-to-date and efficient prime movers. It is designed to burn pulverized solid fuels, oil, or gas, singly or in combination, thus utilizing at high combustion efficiency the least expensive fuel obtainable in any locality.

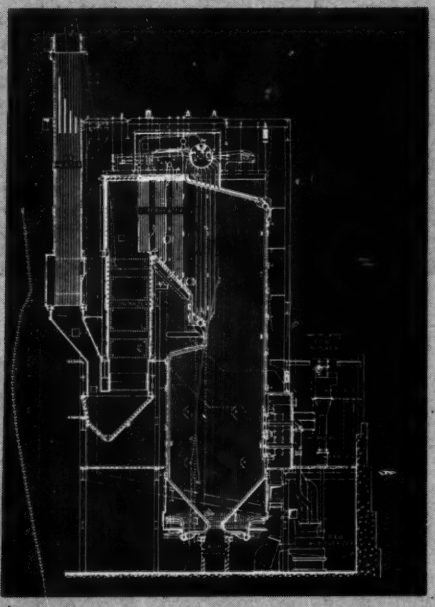


B&W CROSS-DRUM BOILER

This straight-tube sectional-header boiler is noted for its dependability, long life, and ability to deliver dry steam at high ratings. Can be readily inspected and cleaned.

CENTRAL-STATION BOILERS

High-duty boilers for central-station service are available in several basic designs to meet the requirements of individual stations. The Radiant boiler unit illustrated is typical of some of the units now operating at high rates in utility plants.



BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N. Y.

G-294F

. . . and here are MORE PRACTICAL P

When it comes to translating power plans into power plants, the Babcock & Wilcox Company can supply reliable and efficient boiler units complete with all essential components from fuel preparations and burning equipment to breechings and stacks. The company thus has control over both the designing and application of the equipment and coordinates the various elements to assure maximum dependability and economy of performance.

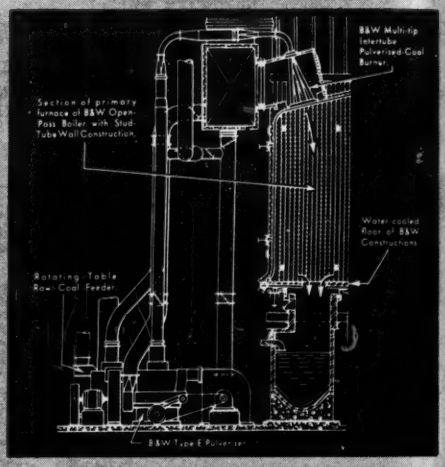
Much of the component equipment shown on these pages can be applied to modernizing, and thereby step up the efficiency of, existing power facilities.

When you select B&W steam-generating equipment for large or small plants, you get the benefit of over 60 years specialized experience in designing and fabricating boilers and related equipment with a long record of highly satisfactory service.

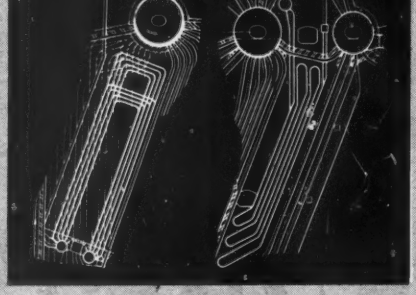
SEVEN STEPS TO A MODERN POWER PLANT

1. List minimum equipment and material essential to keep plant running for perhaps three years.
2. Meter, check, or estimate use of kwhr, steam, water, and air for each plant use, keeping postwar expansion possibilities in mind.
3. Make rough plan of the entirely new plant you would want to serve these needs. Secure costs of equipment and construction from consulting engineer or direct from manufacturers.
4. Compare new-plant plans with existing layout to find points of parallel arrangement, suitable locations for needed new items, building changes and the like.
5. Estimate fuel, labor and perhaps maintenance savings for each step of the modernization.
6. Calculate how long each individual improvement will take to pay for itself.
7. Prepare brief report suggesting that needed steps be approved first. Optional improvements can then be examined individually on the basis of the savings each will effect.

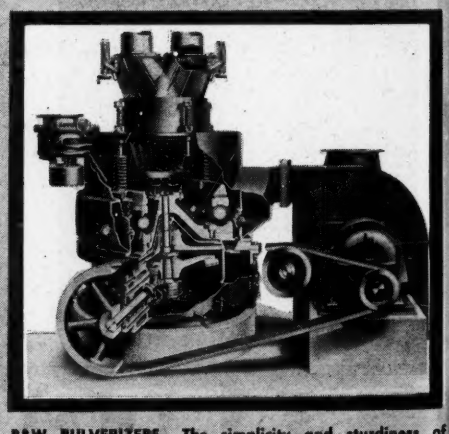
From POWER, December 1944


B&W Multiple Interlube Pulverized-Coal Burners
Section of primary furnace of B&W Open-Pass Boiler with Stud-Tube Wall Construction
Water-cooled Roof of B&W Construction
Rotating Table Raw-Coal Feeder
B&W Type E Pulverizer

B&W DIRECT-FIRING PULVERIZED-COAL SYSTEM. B&W direct-firing pulverized-coal system has advantages in ease of operation, reliability and upkeep that make it economical for small as well as large boilers. It is readily applied to oil-fired boilers for conversion to coal firing.

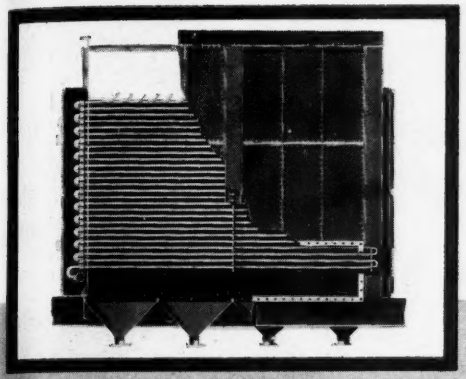


SUPERHEATERS. B&W Superheaters are properly designed and fabricated, with respect to steam and gas flow, to function efficiently with boilers designed and built by B&W. Available in both draining and non-draining types as shown.

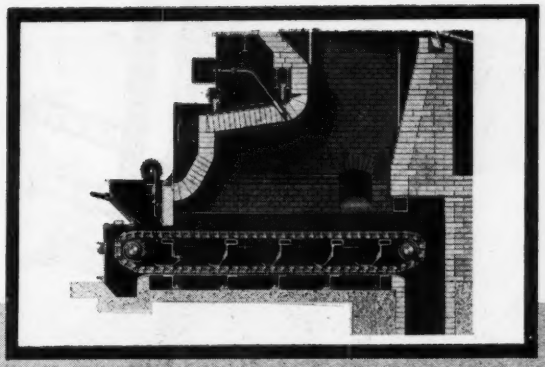


B&W PULVERIZERS. The simplicity and sturdiness of B&W ball-bearing type pulverizers assure high availability with low maintenance in direct-firing pulverized-coal systems. They provide consistently high fineness and respond quickly to changes in load with automatic control of raw-coal feed.

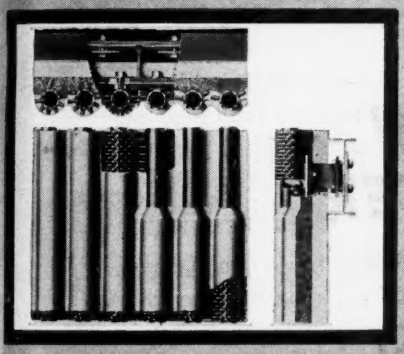
L POINTERS *for* POWER PLANNERS



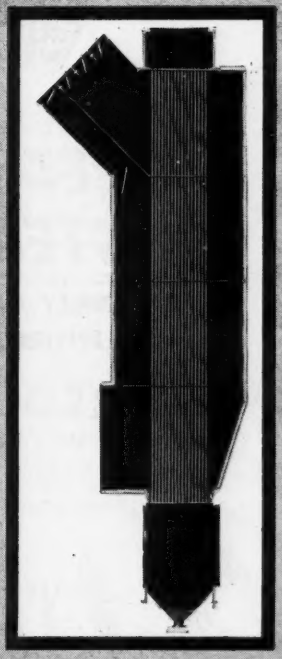
ECONOMIZERS. B&W Economizers effect appreciable savings in fuel and can be built to meet the size and pressure requirements of any installation. The Return-Bend Economizer shown can be easily cleaned, and pressure parts may be inspected externally while in service.



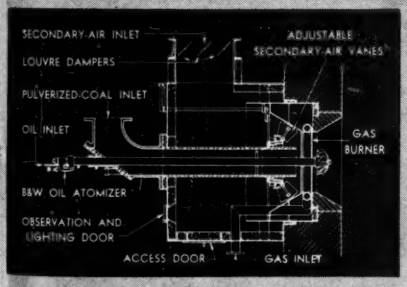
CHAIN-GRATE STOKERS. Babcock & Wilcox Chain-Grate Stokers are widely used with free-burning bituminous coal, anthracite, lignite, and coke breeze. They can be furnished for natural, induced, or forced draft, depending upon operating conditions.



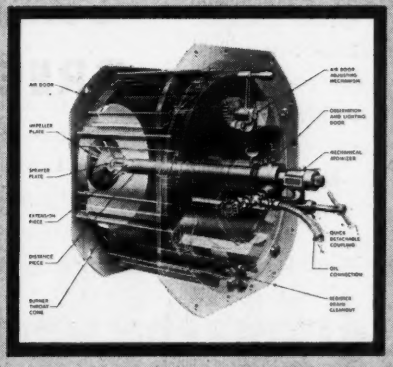
WATER-COOLED FURNACE CONSTRUCTIONS. B&W Water-Cooled Furnace Constructions are extensively applied for partial or complete water cooling of furnaces of all sizes, shapes, and forms, and with all fuels and combustion methods. Studded-tube type of construction is shown.



AIR HEATERS. B&W Tubular Air Heaters are inherently tight and efficient, and are easy to keep clean. Available in multi-pass gas flow type, as shown, or longitudinal gas-flow type, and in sizes to meet the requirements of any boiler installation.



MULTIFUEL CIRCULAR BURNER. Pulverized solid fuels, oil, and gas are burned singly or in any combination with this burner. It provides a single means of efficiently burning a wide range of fuels, permitting advantage to be taken of variations in the availability and market prices of these fuels.



OIL BURNERS. B&W Oil Burners effect rapid and complete combustion at all rates of fuel feed, using mechanical, steam, or steam-mechanical atomizers, depending on the oil and operating conditions. Available in a range of heat liberating capacities that meet all requirements.

THE BABCOCK & WILCOX CO. • 85 LIBERTY STREET, NEW YORK 6, N. Y.

BABCOCK & WILCOX

G-294G

RED
IS STEAM
AN EMPTY GLASS
IS ENTIRELY
RED
GREEN
IS WATER
A FULL GLASS
IS ENTIRELY
GREEN

Over 2000 DIAMOND BI-COLOR WATER GAUGES

Water Always Shows Green
Steam Always Shows Red

More than 2000 Diamond Bi-Color Water Gauges have been placed in service. The Bi-Color Gauge makes boiler water level reading *sure,* no matter how inaccessible the gauge may be.

Ready and rapid acceptance of these Gauges is an index of the value they offer to power plant engineers.

By a simple, invariable optical principle, the Diamond Bi-Color Water Gauge always shows the water as green—always shows the steam as red. The dividing line between the two colors is the water level. This line follows water level changes instantly . . . with no lag at all.

Operators do not have to determine water level by unaided sight. They do not have to depend upon reports at intervals from water tenders in a high gallery. They do not strain to read a gauge high over head. Reading is so clear it can be mirrored to operating level from a high drum through as many as three platforms of grating without the slightest confusion. The image may be made a part of the control panel—right under the operator's eye.

Write for Bulletin No. 917-A.

DIAMOND POWER SPECIALTY CORP.

Detroit 31, Michigan

DIAMOND SPECIALTY LTD. • Windsor, Ontario

How to tube a heat exchanger for new high temperatures ...new high pressures

If you were to look inside the feedwater heaters of the latest high pressure power plants, you would see how one of the major problems of high temperature–high pressure operation was solved in constructing these units.

The problem was to find tubing material that could withstand higher temperatures and higher pressures than had ever been tried before.

The tubing had to be stronger at elevated temperatures. It had to be corrosion-resistant to maintain a smooth surface and prevent accumulation of sludge and salt deposits. It had to have good heat-transfer properties. It had to be hard and tough to resist erosive wear. And it had to be ductile, so that it could be readily expanded into tight head connections.

In checking over possible materials, three groups of engineers, working independently on this problem, came out with the same answer: *Monel has the combination of properties necessary to meet the requirements.*

★ At the Twin Branch plant of Indiana and Michigan Electric Company, subsidiary of the American Gas and Electric Service Corp., Monel tubing was installed in a pre-heater handling 550,000 pounds of water an hour at 3200 pounds pressure per square inch—under external temperature of 637° F.—feeding a boiler operating at 2500 pounds steam pressure!

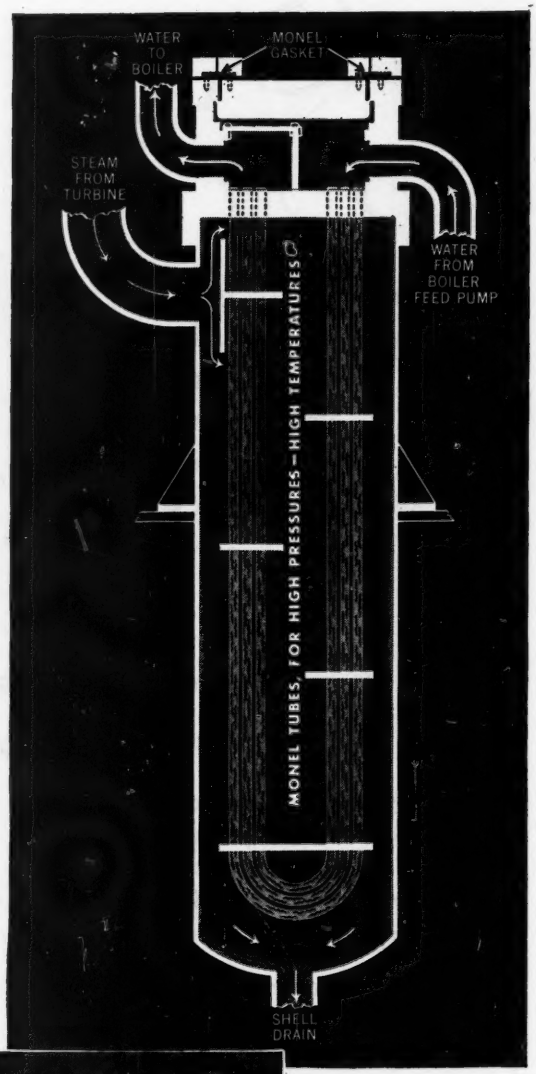
★ In Providence, R. I., the Narragansett Electric Company put one new high pressure boiler to work generating three times the power formerly obtained from eight low pressure units... using Monel tubing under external heat of 700° F., internal pressure of 1300 psi.

★ In the Oswego plant of the Central New York Power Corp., Monel heater tubing was installed to operate under 2000 pounds water pressure, at an outside temperature of 770° Fahrenheit.

Recently, these installations were examined after 3 to 4 years' service and their performance has confirmed the choice of Monel as a practical answer to the problem—the Monel tubing was still operating perfectly.

If you are considering the installation of high temperature-high pressure equipment, here is one problem that has already been solved for you. For a more complete discussion of the problems encountered and overcome in the Providence, Oswego and Twin Branch installations, write for a reprint of the article "27 TIMES THE POWER OUTPUT..." It includes the table of maximum allowable design stresses for non-ferrous materials taken from the proposed A.S.M.E. Boiler Code, and additional information about Monel heat exchanger tubing.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York 5, N. Y.**

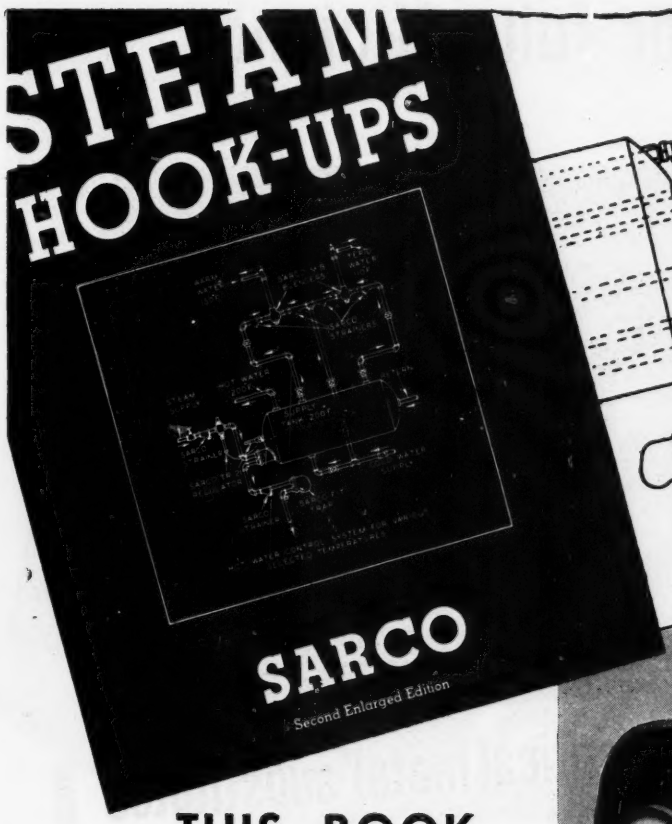


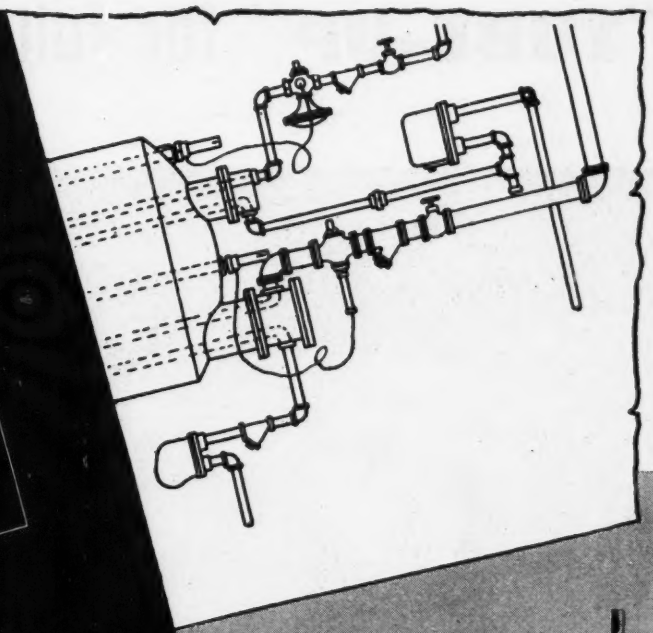
EXPANDING TUBES *into the head of a pre-heater at Twin Branch. The excellent working properties of Monel are here in evidence. Monel tubing is ductile...can be expanded into snug-fitting durable connections with the head.*

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings

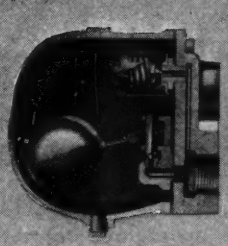




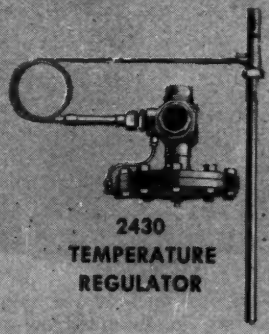
THIS BOOK SHOWS WHERE AND HOW TO SAVE WITH SARCO

The Sarco Hook-Up book, now in its third edition, gives calculation data, recommendations, hook-ups for heating, cooling and process operations, and a brief description of all Sarco products.

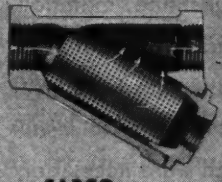
Send for yours today



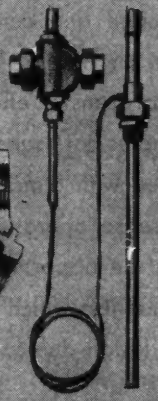
FT STEAM TRAP



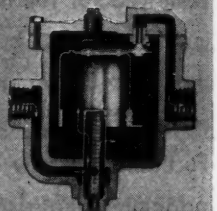
2430 TEMPERATURE REGULATOR



SARCO STRAINER



TR-21 TEMPERATURE REGULATOR



BUCKET TRAP

17

SARCO

"TUBE-UP" for full efficiency

Lummus heat exchangers — purchased for war emergency power plant and central station use during critical metal shortages — should now be reviewed for full heat transfer efficiency. In many instances tube bundles of substitute materials may now be replaced with bundles fabricated of metals that will increase operating performance. Furthermore, now is the opportune time to install additional heat exchangers which were necessarily omitted from plant design due to wartime restrictions.

Lummus engineering service is available for making such a review and for the study of specific metal replacement problems and the modernization of power plants to meet post war requirements. For further information write to:

LUMMUS POWER PLANT EQUIPMENT

SURFACE CONDENSERS
•
STEAM JET AIR EJECTORS
•
BLEEDER HEATERS
•
BOILER BLOWDOWN HEAT EXCHANGERS
•
EVAPORATORS
•
FUEL OIL HEATERS
•
LUBRICATING OIL COOLERS

THE LUMMUS COMPANY, 420 LEXINGTON AVE., NEW YORK 17, N.Y.

LUMMUS

HEAT EXCHANGERS

LIQUID LEVEL TARGET for EYES

OUTSTANDING FEATURES

Eye Level Readings **of boiler water or other liquid levels on instrument panel or other convenient location.**

•

Instant, Accurate Indication **—a positive check on remote, hard-to-see liquid level gages.**

•

Operated by the boiler water —itself. **"Positive as the law of gravity."**

•

No stuffing boxes. Frictionless Mechanism **— Jewelled Bearings.**

•

Indicating mechanism never under pressure. **Magnetic transmission between actuating and indicating mechanism.**

•

Indicates in full or reduced scale. **Up to 8 ft. level variation.**

•

Compact—Moderately Priced. Available for all pressures up to 1500 lb.

•

Easily Installed **on new or existing equipment.**

Now, stop squinting and guessing at boiler water levels. End the risk of serious damage to important equipment. Keep accurate check on other liquid levels in your plant.

With the Yarway Remote Liquid Level Indicator—"the Eyes have it" all the time, right in front of them—on instrument panel or wall, wherever it's most convenient and prominent. Quick, accurate, eye-level readings regardless of location of the levels to be checked.

Hundreds in Use

Read the features listed at the left. Facts that have already influenced the purchase of hundreds of Yarway Instruments for utilities, industrial plants, institutions and marine service.

And everywhere, use has multiplied satisfaction with this positive, accurate, dependable, *popularly-priced instrument.*

A Development of the Yarway Steam Laboratory

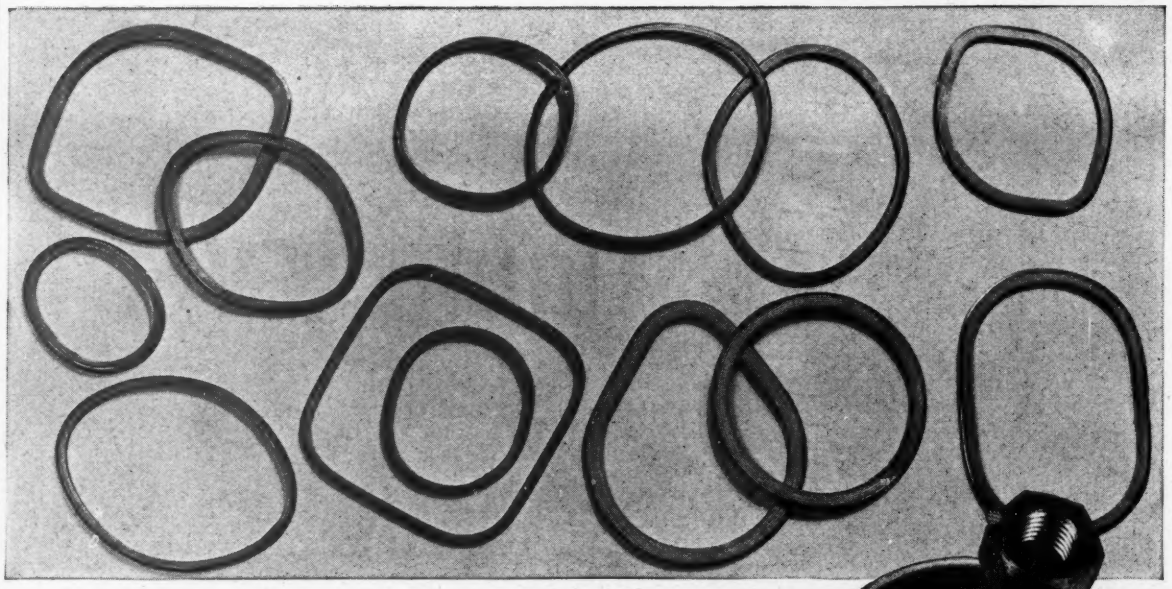
The Yarway Remote Liquid Level Indicator is another development of the unique Yarway Steam Laboratory, responsible for all new Yarway products and improvements. Here, a device must be right or it never meets the public. For instance, for the past three years, an accelerated endurance test has been carried out on a standard stock Yarway Indicator. In continuous operation, day and night, under rapidly-changing liquid levels that produced full pointer travel, the mechanism has operated through 17 million complete travel cycles —equivalent to 50 years of ordinary boiler room service, with no repairs, replacements of parts or change in calibration.

Why not get this positive, dependable, convenient indication of the liquid levels in your plant?

For further information, write for Bulletin WG-1820.

YARNALL-WARING COMPANY • 114 Mermaid Ave., Phila. 18, Pa.

YARWAY REMOTE LIQUID LEVEL INDICATOR



AJAX

"INSTALLED ECONOMY"

HIGH and LOW PRESSURE BOILER GASKETS

High speed production machinery and the quality of U. S. Gasket-engineering assures the consistent accuracy of AJAX Gaskets. Complete listing in Catalog 202.

Boiler "outage" held to minimum! Power, industrial and marine engineers confirm this direct result of installing AJAX Spiral Wound Gaskets in their manhole, handhole, tubecap and other boiler assemblies.

AJAX metal-asbestos boiler gaskets are available in these major pressure ranges — 0 to 499 lbs., 500 to 999 lbs., and 1000 lbs. up. Stainless steel is recommended for pressures over 500 lbs. — however, both construction materials and the number of spiral wound plies per diameter are determined by your particular service requirements or specifications.

AJAX Gaskets are easy to install and remove. They seal securely under a comparatively low bonding pressure, which eliminates excessive strain on fittings. The springback or "breathing" quality of AJAX Gaskets compensates for temperature and pressure fluctuations.

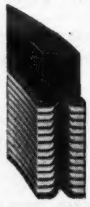
Assurance in service . . . trouble-free installations . . . these are true gasket economies, the economy of AJAX Spiral Wound Metal and Asbestos Gaskets.

Distributors in Principal Cities ★ ★ *A few choice industrial territories are open*

Write today for complete AJAX data—available in Catalog 202

U. S. GASKET CO.

1596 PIERCE AVENUE, CAMDEN, NEW JERSEY



★ **"THE STORY BEHIND THE GASKET THAT BREATHES"**

Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

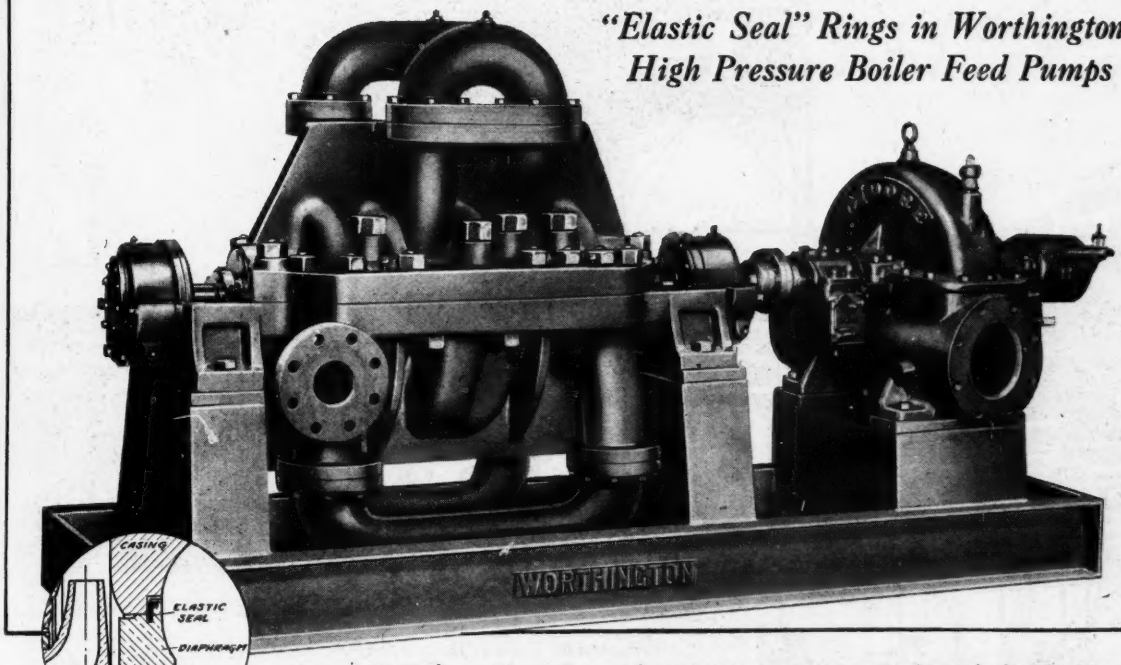
There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

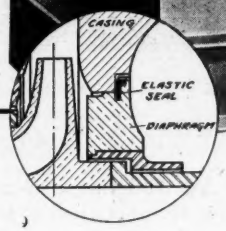
The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions — and retains the positive, secure seal you require at all times.

The above cutaway is the AJAX SR Compression Gauge Flange Gasket

THEY TIGHTEN THEIR OWN JOINTS TO MAKE HIGH PRESSURE SAFER

"Elastic Seal" Rings in Worthington High Pressure Boiler Feed Pumps





51,370 hours with no time out for maintenance — was the typical record of a Worthington Type UX Boiler Feed Pump, installed in a famous plant.

First to build high pressure boiler feed pumps in the U. S. (the first pump above 1200 p.s.i. was installed in 1923), Worthington has continued to advance centrifugal pump design. The Worthington Elastic Seal Ring is only one example.

Eliminates common cause of pressure loss. Inter-stage cutting, a serious danger in all boiler feed pumps with horizontally-split casings, becomes even more serious as pressures increase. The Worthington Elastic Seal Ring — flexible, resilient — seals rigid interstage diaphragms against rigid casings, so that the resulting joints are liquid tight.

Initial seating assured by the flexibility of the seal ring.

The higher the pressure, the tighter it gets. The Elastic Seal Ring is so arranged that the pressure developed in each stage tends to seat each joint more tightly.

Investigate — today — the many other advantages of Worthington's type UX centrifugal pumps for high pressure boiler feeding radially and axially balanced — with the interstage loops representing the best in hydraulic design — freedom from thrust and stuffing box troubles — absence of shaft vibration — low power and maintenance costs. Telephone to your nearest of our 24 District Offices, or write us, *Worthington Pump and Machinery Corporation, Harrison, N. J.*

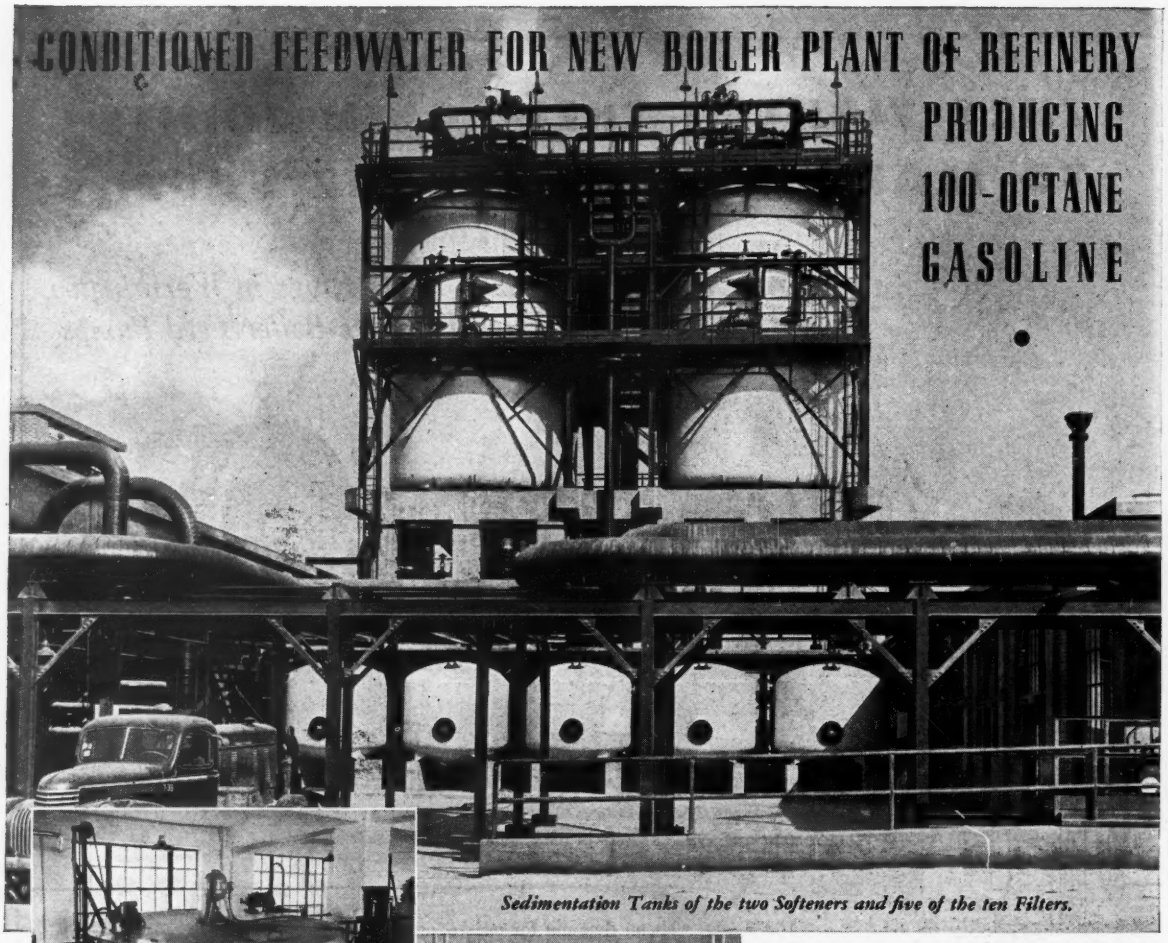
MEMBER HYDRAULIC INSTITUTE

WORTH BEHIND THE NAME
WORTHINGTON

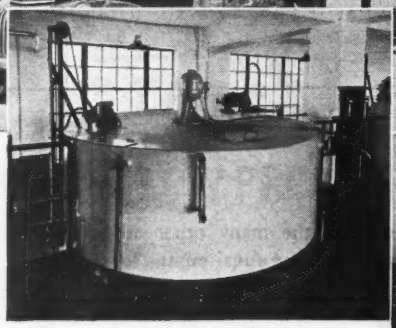
CP4-23

THE WORLD'S LARGEST MANUFACTURER OF PUMPS

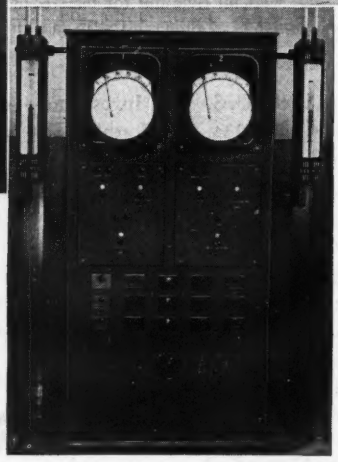
CONDITIONED FEEDWATER FOR NEW BOILER PLANT OF REFINERY PRODUCING 100-OCTANE GASOLINE



Sedimentation Tanks of the two Softeners and five of the ten Filters.



Above—Chemical Mixing Tank.



Right — Cochrane Flow Meter Panel Board for Automatic Control of Acid Feed.

AT one of the big California refineries now devoted to the production of 100-octane gasoline exclusively, the installation illustrated here, consisting of two 50,000 GPH, Cochrane Deaerating Hot Process Softeners, with ten 9′ dia. Filters, Mixing Tank, etc., supplies conditioned feedwater to the new high-pressure boilers. Many unique Cochrane features distinguish this installation, among which are a stirring mechanism which reduces turbidity to less than 5 ppm, automatic sludge blow-off, backwashing of filters with filtered water and panel board control of chemical feeds. • Write for complete details of this job or for a copy of Publication 3000, "Hot Process Softeners."

COCHRANE CORPORATION • 3123 N. 17TH STREET • PHILADELPHIA 32, PENNA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

Packer Saves $250 Per Season on Oil—British Columbia Packers, Ltd, saved more than doubl... ...inal cost of their Arm... ...first year they wer...

Laundry Model La... six Armstro... ...k is...

Elimin... Type H... two Arm... heater at eliminated ... to rupture th...

Laundry Cuts ...eer-less Laundries, ..., one of the world's ...ndries, reduced heating up time by 30 minutes, reduced maintenance cost 8% by installing Armstrong Traps.

Cannery Saves a Boiler—Bestovall Canning Company, Vancouver, B. C., didn't need a new 65 H.P. boiler after installing 7 Armstrong Traps.

Textile Mill Produces Better Yarn—Glenwood Mills, Easley, S. C., installed Armstrong Traps on slasher headers to save steam and gained the added benefit of producing better yarn because the steam to the slashers was dry.

Chemical Plant Saves $2500 on Fuel—Midland Chemical Laboratories reduced fuel oil consumption $2500 annually with 16 Armstrong Traps and found that a new 80 H.P. boiler would handle the load instead of the 125 H.P. boiler that would otherwise have been necessary.

Cuts Coal Bill $650 Annually—A Huntingburg, Ind., firm spent $417 for Armstrong Traps and saved $650 on coal the first year they were installed.

Academy Heats Up Buildings 50% Faster—New York Military Acad... ...buildings are heated ... formerly requ... water h... vege... time—...

Platin... At Ba... sas... crea... unif... ...proved... ...ced coal...

...e Equip... Coal—... ment... ...ong... ...hours, ...gine...

27% Wa... N.H... fue... Ar...

...uniform p... ...improved the qua... ...duced coal consumption.

Store Equipment Concern Saves 170 Tons Coal—At the Northwestern Store Equipment Corp., Milwaukee, Wis., Armstrong Traps save 170 tons of coal per year; heating-up time on wood drying kilns cut from 5½ hours to 2½ hours, and back pressure on steam engine used to drive line shafting dropped from 7-10 lbs. to 2 lbs.

...avings in a large ...for traps in ... speed ... Na-...al-...in-...m

...Re-...an's ...uired ...0 min-...traps.

...sumption ...City High ...ced ... per ...rong

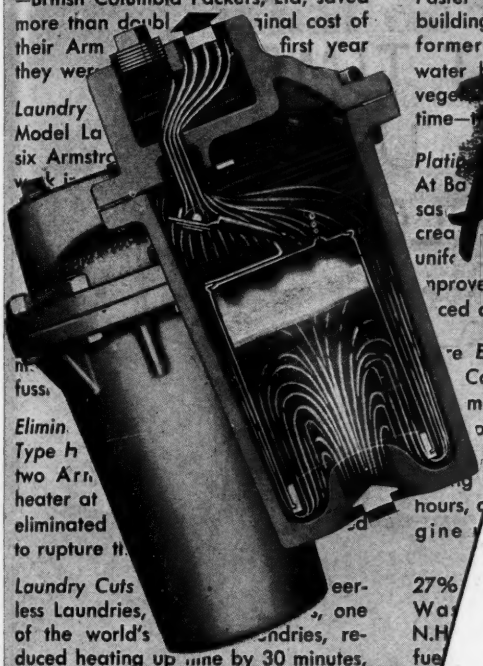
...s at ...way-...c, re-

...ngs for ...form'a ...nt heats ... 80°F. to ...Armstrong ...duced ap-...s in a large ...for traps in ...oking speed ...cott Co., Na-...ks 11,000 gal-...ly 20-25 min-...derable steam

...Cooking Time Re-...ng Plant Bulman's ... cut time required ...o boil from 10 min-... Armstrong traps.

...s Coal Consumption ...ringfield City High School, ...field, Ohio, reduced coal consumption from 8-9 tons per day to 4, by installing 30 Armstrong traps!

Ten Years Without Trap Repairs at Wisconsin Milk Plant—The Galloway-West Condensery, Fond-du-Lac, reports of their Armstrong installation.



How Important are STEAM TRAPS?

... judging from the records of Armstrong Steam Trap installations printed on this page, it might seem that no other single item of plant equipment can have such a great effect on fuel consumption. boiler capacity and production rates of steam equipment.

Good traps in good working order pay big dividends!

It follows that efficiency and dependability should be your first considerations in selecting steam traps.

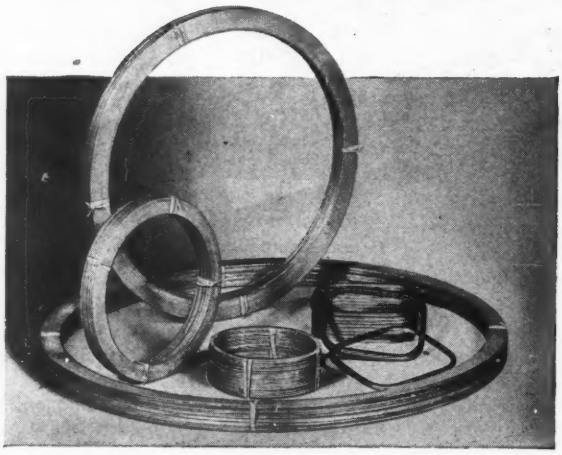
Armstrong offers you an improvement over their *original* inverted bucket design; stainless steel working parts; self scrubbing action; freedom from wiredrawing, sticking or clogging; automatic air elimination and no steam leakage.

For information on prices, sizes, capacities, physical data, material specifications, installation practice, maintenance and trouble shooting refer to the 36-page ARMSTRONG STEAM TRAP BOOK. Free on request.

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Mich.

ARMSTRONG STEAM TRAPS for **POWER PROCESS HEATING**

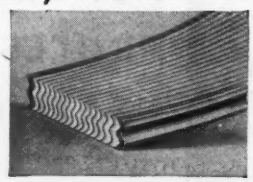
Over a million in use!



GARLOCK GUARDIAN GASKETS

are Rugged, Resilient, Reliable . . .

These semi-metallic gaskets are specially designed for joints subject to expansion and contraction with changing temperatures. The easy compression and instantaneous rebound also keep joints tight in equipment that vibrates.



Standardize on GARLOCK for Dependability!

Pack up your troubles by using Garlock Packings, Gaskets and Oil Seals. They give *dependable* performance because they are produced in our own plant and are *quality-controlled* from raw material to finished product.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock

What do you want to know about Turbine Oil?

Recently a number of utility plant men were asked, "What do you want to know about turbine oil?" Several of them had very specific questions. They are answered here because they may help you in selecting a turbine oil that solves, once and for all, the ever present problem of turbine oil maintenance. One question is taken up each month, but you can get the answers to all of them now—see the booklet offer.

5. Does the inhibitor in Nonpareil Turbine Oil wear out?

Inhibitors are used in many oils for various purposes, often without users being aware of it. But in Nonpareil the addition of an inhibitor is an important step in its manufacture—it's the key to the oil's long life.

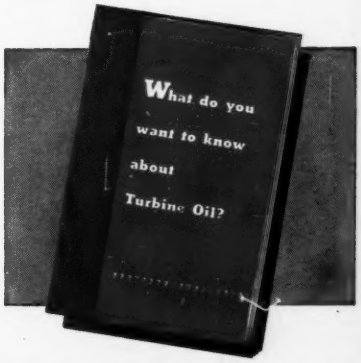
Few, if any, oils are expected to last indefinitely; therefore, the life of inhibitors used in them is not of paramount importance. Since Nonpareil is guaranteed "for the life of the turbine," the lasting quality of the inhibitor *is* important.

It is true that the oxidation inhibitor in Nonpareil is slowly consumed in service. But the user has no cause for concern about it. There are many reasons why. The principal reason is the fact that the inhibitor is used up so slowly—and such a small amount is needed to prevent acidity development—that it is usually amply replenished by the make-up oil. Almost every turbine requires some oil to replace that lost through evaporation and leakage. Normal make-up oil will keep Nonpareil well within the guaranteed limit of acidity formation.

Another reassuring fact is that the oxidation inhibitor has one primary function—to prevent acidity development. The oil itself is free from asphaltene-forming hydrocarbons. Even in the extremely rare case where make-up oil is not sufficient to replenish the inhibitor, there is no formation of asphaltene deposits. However, the possibility of *any* oil trouble because of a deficiency of inhibitor is reduced to practically zero due to the periodic laboratory check that is made of every fill of Nonpareil. Records of thousands of these tests bear out this fact.

What causes corrosion in turbines will be the question discussed in this space next month.

Gasoline Powers the Attack...
Don't Waste a Drop!



For all the answers send for this booklet...it contains answers to questions such as these:

1. What causes turbine oil deposits or sludge?
2. What causes acidity increase in turbine oil?
3. What is an oxidation inhibitor—how does it prevent acidity?
4. How does a guaranteed turbine oil protect the user?
5. Does the inhibitor in Nonpareil Turbine Oil wear out?
6. What causes corrosion in turbines?

Send for a copy of this booklet, or better still, ask for a Standard Lubrication Engineer. He can answer your specific questions about Nonpareil Turbine Oil. Write Standard Oil Company (Indiana), Room 1223, 910 S. Michigan Ave., Chicago 80, Ill., for a copy of the booklet, or the Engineer nearest you.

NONPAREIL TURBINE OIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Rust prevention made easier and surer with . . .

STANORUST

MOST OILS or greases will give some measure of rust protection, but a product specifically developed for rust prevention will make the job easier, give more reliable, longer-lasting protection, and cost less in the end.

There are 18 grades of Stanorust and "SR" rust preventives—each has specific uses and advantages. Some of them were specifically made to meet U. S. Government specifications. If you have a problem of rust prevention on: stock in storage, parts in production, or complete machines to be shipped or stored, let us help you pick the grade or grades of Stanorust you need—and make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois. Your questions will be answered or referred to the Lubrication Engineer nearest you for handling.

Gasoline Powers the Attack . . . Don't Waste a Drop!

STANORUST GIVES COMPLETE RUST PROTECTION *PLUS* THESE ADVANTAGES

1. Easy application. Because Stanorust is available in grades for spraying, swabbing, or dipping, and for hot or cold application, you can choose a product that is easiest to apply under your present conditions.

2. No waste. The wide choice of grades also makes it possible to apply the exact film needed to give the protection which the job requires.

3. Does not crack or peel. Stanorust does not harden or form a paint-like film which will be chipped off or damaged in handling.

4. Easily removed. Most grades of Stanorust can be removed by wiping the parts clean with a cloth dampened with petroleum solvent.

5. Acts as a lubricant. It is not necessary to remove Stanorust from parts that are to be assembled in a complete machine. Stanorust, itself, acts as a lubricant.

6. Light color.

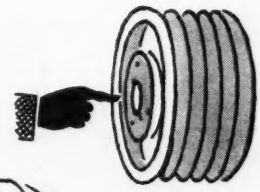
7. Noninjurious to workers.

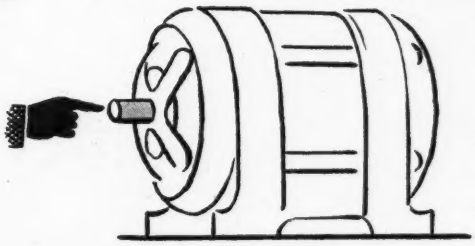
8. No unpleasant odor.

STANDARD OIL COMPANY (INDIANA)

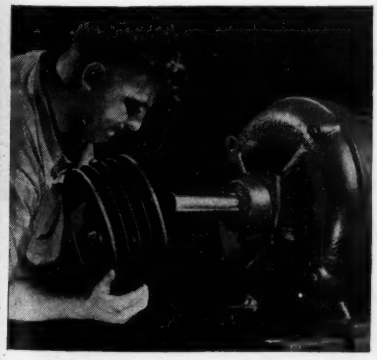
STANDARD SERVICE

See how Easy it is to put this on this

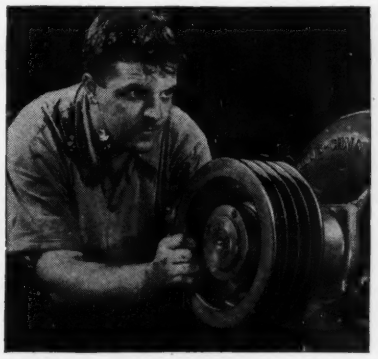




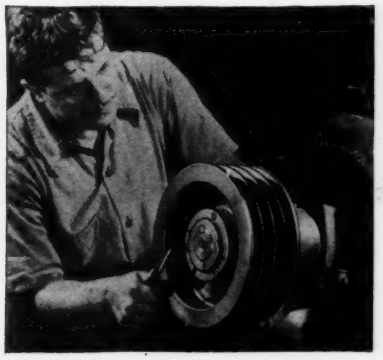
One quick operation and Allis-Chalmers' new "Magic-Grip" — *fastest mounting sheave on the market* — is locked securely to shaft... saving you time, money, trouble!



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge ... giving you true alignment with resulting smooth performance. A minimum of time is required.

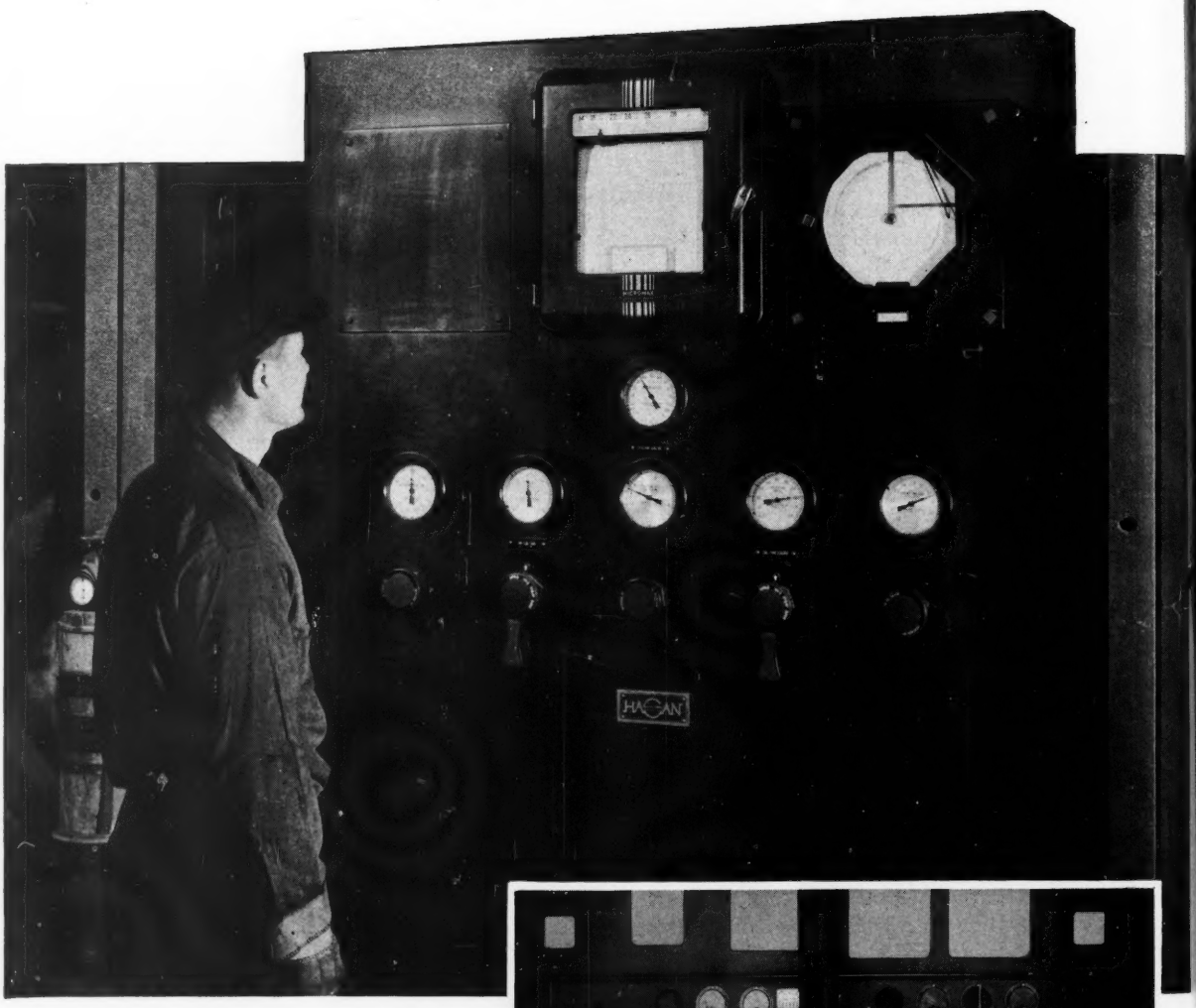


3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1750

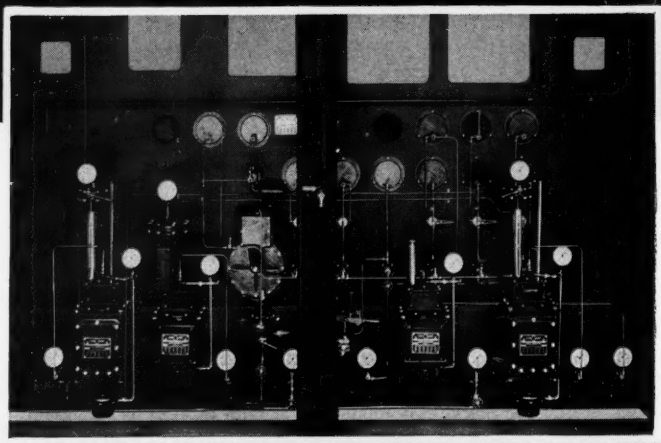
Allis-Chalmers Texrope "MAGIC-GRIP" SHEAVES

Hagan provides the answer



$10,000 a year saved on fuel by this installation of Hagan Control on a bar-heating furnace of a large steel mill.

Quick, low-cost installation. Hagan Control is mounted on a panel with all connections made ready to be hooked into your system.



to a burning question :

How can you conserve on fuel while meeting demands for more steam?

FUEL conservation, today, is more than a matter of sound economics, it's a national necessity. More precious even than the money fuel costs are the man-hours it takes to supply enough fuel to keep war industries going. Fuel *must* be conserved this winter more than ever. There's less of it than needed. It's harder to get.

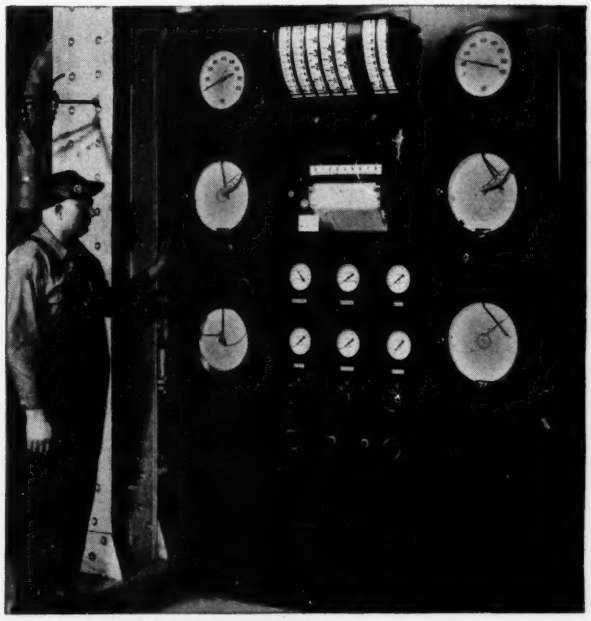
How to do it and keep up steam requirements? We know only one answer and none could be better. *Burn it more efficiently.* Get more out of it. Lose less of it up the smokestack.

That's where Hagan can help you. Hagan Automatic Combustion Control is already saving fuel on a large share of the nation's boilers and industrial furnaces . . . but most plants have individual units that need modernization. Some of the greatest fuel savings have been made when boilers have been rebuilt to include Hagan Automatic Control.

In many cases, the complete use of Hagan Control on all boilers in a plant has made the purchase of a new boiler unnecessary.

For industrial furnaces and process work, automatic control will often pay for itself in less than a year and result in faster production, more uniform quality of products.

With labor and material costs rising, it will be necessary to reduce fuel costs wherever possible. Write for the complete facts on Hagan Control.



Saving fuel in the power plant of a large woolen mill. Steam pressure kept constant by Hagan Control in spite of fluctuating demand.

HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion (for high efficiency.)

MAXIMUM UTILIZATION value and uniform steam pressure.

MAXIMUM OUTPUT from boilers of different capacities.

MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

The TERRY

TERRY
SOLID WHEEL TURBINE
ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

— The Terry wheel will withstand abuse that would wreck any built up wheel.

THE TERRY STEAM TURBINE CO.

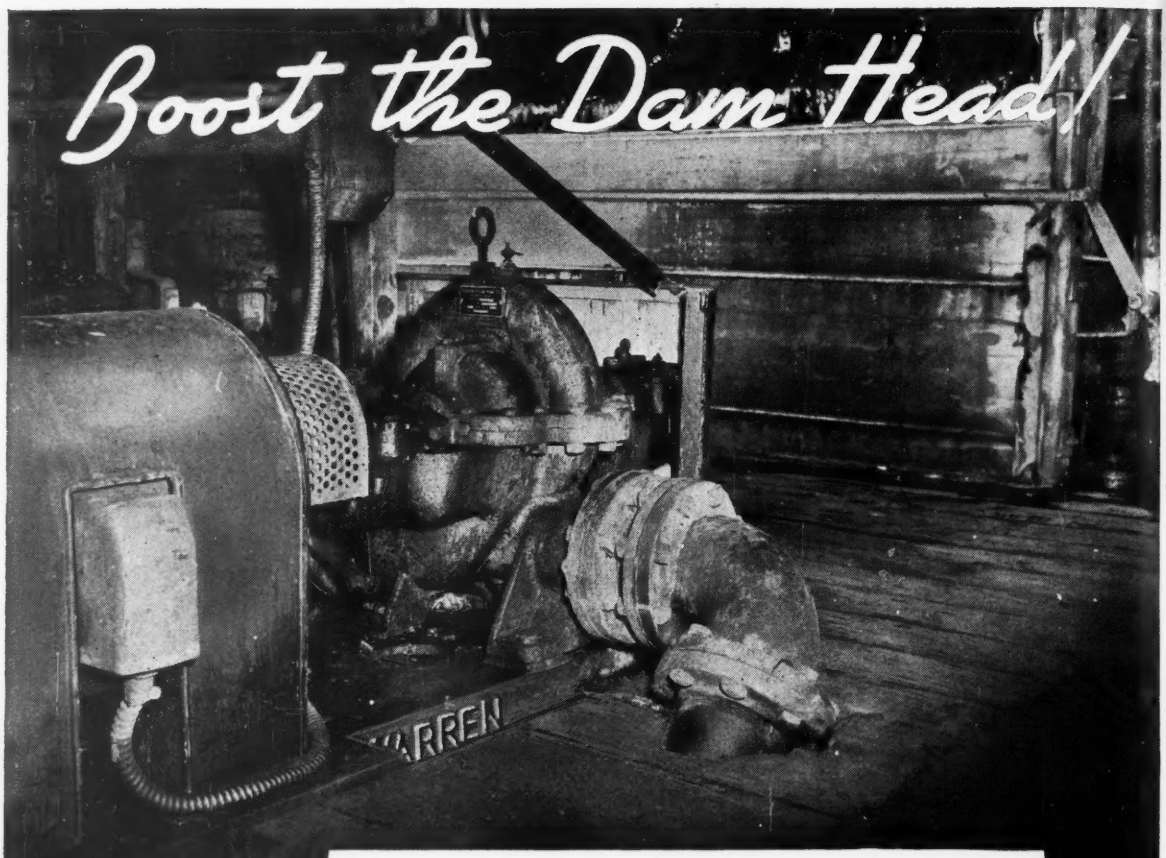
Wheel Turbine

At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized

T-1147

TERRY SQUARE - HARTFORD, CONN.

Boost the Dam Head!



One of three Warren Pumps on booster service at Uxbridge Worsted Co., Inc.

That was the water supply problem at Uxbridge Worsted Co., Inc., Uxbridge, Mass., su[illegible]ssful operators of a dozen or more plants with an enviable reputation in the woolen and worsted field.

Water supply to the washers and kettles at the mills depended entirely upon gravity feed from the dam head. The supply was slow and inadequate.

Warren engineers were called into the picture — and three Warren horizontal, double-suction booster pumps were installed. Result: production on washers and kettles was boosted threefold.

Also used at Uxbridge Worsted Co., Inc., for boiler-feed and other services, are Warren reciprocating and two-stage turbine-driven centrifugal pumps.

If there is a pumping problem troubling you, turn it over to Warren engineers.

ARMY E NAVY

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

Invaluable to Engineers . . .

• A Series of Technical Papers Based on Original Gasket Research

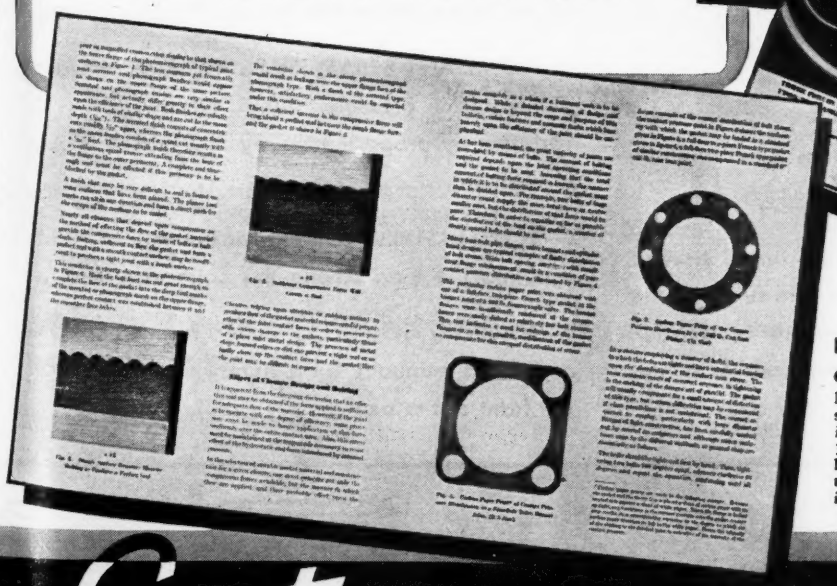
To provide highest joint efficiency — especially mandatory for confining dangerous or corrosive fluids or for withstanding high temperatures and pressures — Goetze, at once, must be expert in metallurgy, mechanical engineering, steam engineering and chemistry.

The unique laboratory at the Goetze plant, continuously engaged in research in the effects of metallic structure upon gasket performance, the determination of true gasket yield stress value and gasket factor, proper flange and bolt specifications, etc., has amassed a wealth of original data of interest to engineers and designers of pressure equipment.

These data are being published in a series of technical bulletins — a part of Goetze service to Industry. If you wish to receive these bulletins regularly, write on your letterhead, mentioning your position.

Also available — a handy up-to-the-minute gasket chart showing the cross sections of 36 most popular gasket types, their purposes and the characteristics which fit them for the specific services intended — is yours for the asking.

GOETZE GASKET & PACKING CO., Inc.
17 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY



LOWELL THOMAS Speaks on New Gasket Film

Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern Industry. Write for full information.

Goetze for GASKETS

"America's Oldest and Largest Industrial Gasket Manufacturer"

CONSERVE FUEL

and lower your steam cost

Are your boilers delivering the amount of steam you are paying for—or are you being short-changed? An automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over long periods at *test efficiencies* regardless of variations in fuel, load and other operating factors.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual devices is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of every-day operation.

Check the following features against your list of "musts" for a perfect combustion control system.

✓ CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

✓ FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

✓ FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

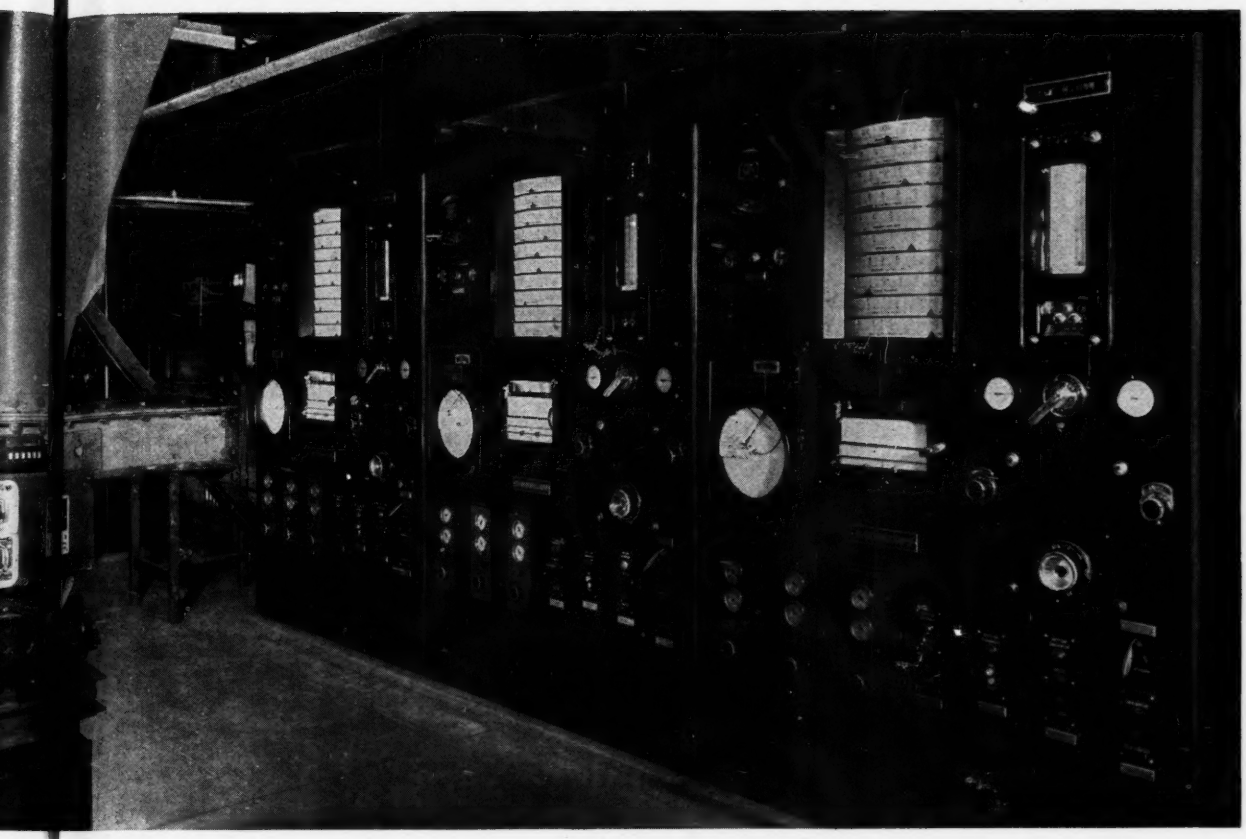
✓ ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

✓ CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

✓ LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

✓ MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

REPUBLIC
INSTRUMENTS
AND CONTROLS



PERFORMANCE FACTS

Here is a list of installation reports, available to you, which present detailed evidence of the savings derived from the installation of Republic automatic combustion control systems in typical boiler plants.

Installation Report No. 43-39
RCA MFG. CO.: 2-125,000 lb. per hr. boilers; 850 lb. pressure, 750 F; pulverized coal or oil fired.

Installation Report No. 51-40
CLINTON COTTON MILLS: 1-70,000 lb. per hr. boiler; 415 lb. pressure, 725 F; pulverized coal fired.

Installation Report No. 60-39
TIMKEN ROLLER BEARING CO.: 1-60,000 lb. per hr. boiler; 400 lb. pressure, 630 F; underfeed stoker fired.

Installation Report No. 70-39
KREY PACKING CO.: 2-35,000 lb. per hr. boilers; 330 lb. pressure; chain grate stoker fired.

Installation Report No. 31-40
SUTHERLAND PAPER CO.: 3-50,000 lb. per hr. and 2-81,000 lb. per hr. boilers; 175 lb. pressure, 450 F; spreader stoker fired.

Installation Report No. 41-40
GODCHAUX SUGARS, INC.: 1-100,000 lb. per hr. boiler; 450 lb. pressure, 560 F; natural gas fired.

Installation Report No. 61-39
WORCESTER SALT CO.: 1-125,000 lb. per hr. boiler; 200 lb. pressure, 400 F; natural gas or pulverized coal fired.

Installation Report No. 120-39
SWIFT & CO.: 2-45,000 lb. per hr. boilers; fuel oil fired.

All these reports are included in Data Book No. S-21. Write for your copy today. We will gladly mail it to you without obligation.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago 47, Illinois

More POWER

for Wyandotte — SECOND DE LAVAL TURBO-ALTERNATOR INSTALLED FOR MODERN MUNICIPAL STATION

Power for the City of Wyandotte, Mich., is generated in part by two DE LAVAL turbo-alternators . . . a 6000 kw. and a 4000 kw. unit; the older unit having been installed in 1940 and the newer unit in 1943. The excellent performance of the first De Laval unit influenced the purchase of the second. • Both units are so arranged that oil pumps and oil lines are isolated from high temperature steam to eliminate fire hazards. • The De Laval Steam Turbine Company is one of the oldest builders of steam turbines and their experienced engineers are prepared to discuss your requirements without obligation.

3529

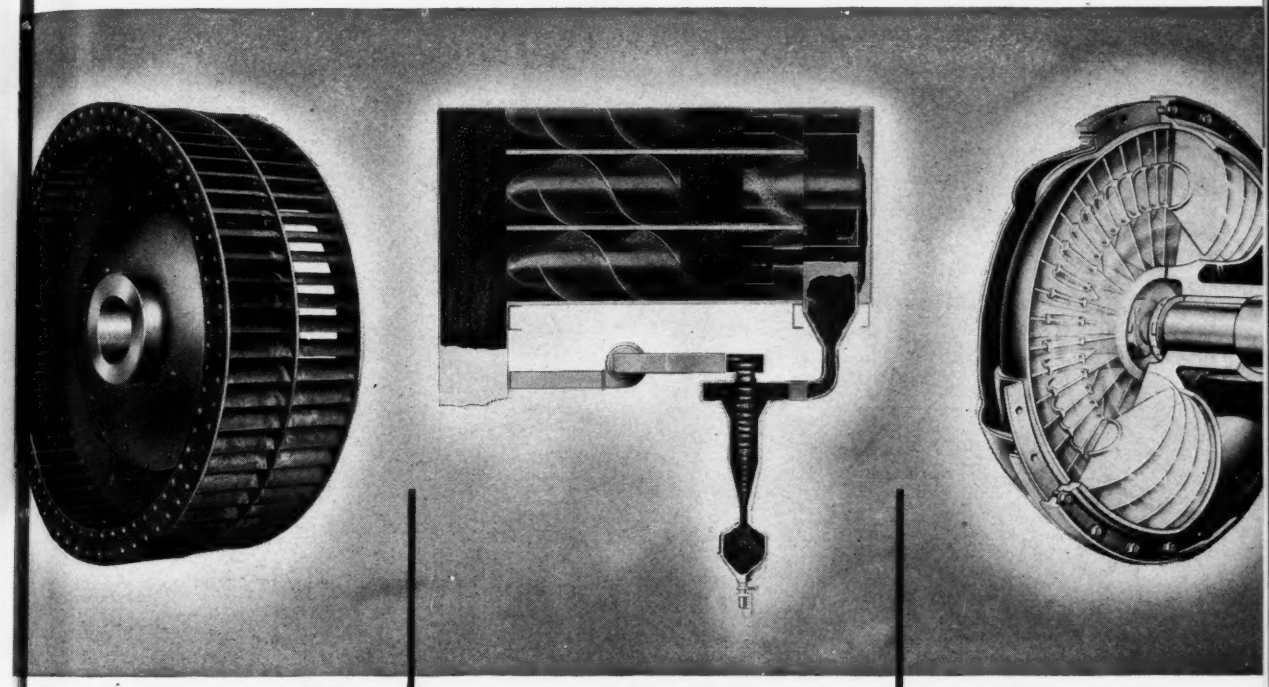
TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG

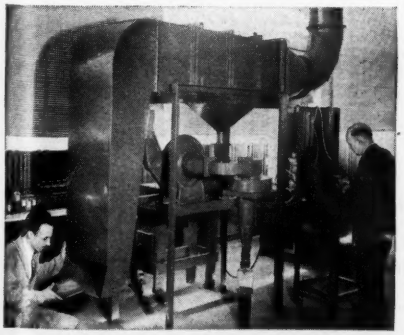
One man sells ALL THREE!



1 American Blower Forced and Induced Draft Fans are widely known for outstanding performing qualities and dependable operation. Many power plant executives say they would not have any other make. Those who want undivided responsibility do not stop with American Blower Fans but take Step 2.

2 American Blower Type ST Dust Precipitator does away with the fly ash nuisance. No water required — no complicated electrical equipment to clean. Far-sighted power plant engineers have found it has another distinct advantage — it definitely reduces fan maintenance. And, speaking of fans, control and fans go together. That's why we remind you of Step 3.

3 Fluid Drive has proved so suc cessful for variable speed fa control, we needn't go into detail Suffice to say, leading power pro ducers tell us Fluid Drive increase overall plant efficiency . . . Best par of it is, one man sells all three. Save your time, provides undivided re sponsibility, greater satisfaction!



HOW TO SOLVE YOUR DUST OR FLY ASH PROBLEMS

The photograph, on left, shows a part of our modern Dust Testing Laboratory Here, special laboratory collectors determine the design necessary to mee any specific problem. In the last 20 years, we have run tests on more than 410 distinctly different materials. These tests include microscopic investigations screen analyses, and collector performance. American Blower not only has th finest facilities for testing, but we also have the largest facilities for building Dust Precipitators. Every Dust Precipitator we sell is built entirely in our own plants. Why not take your problem to the oldest and largest manufacturers o this type of equipment in the world?

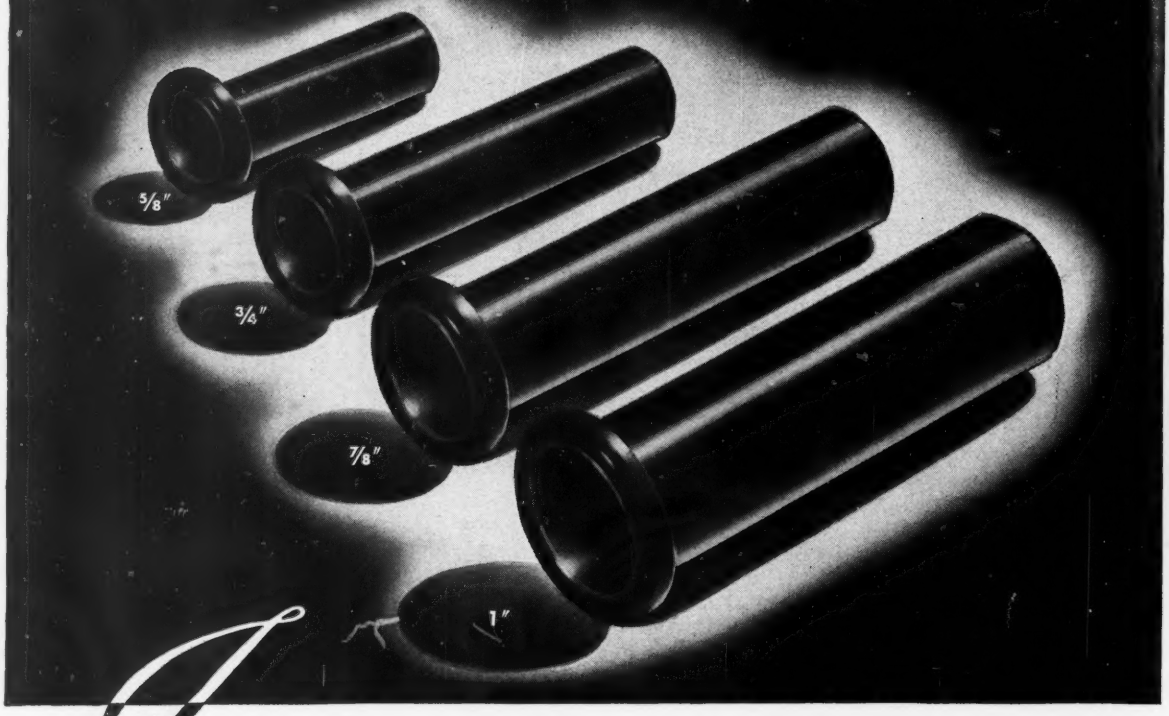
MECH-DRAFT · AIR-CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

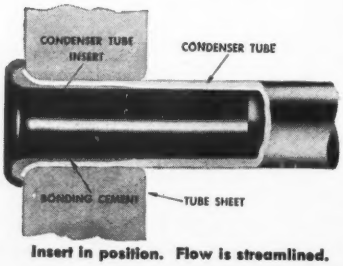
Make CONDENSER TUBES *Last Longer!*



Install JOHN CRANE
CONDENSER TUBE INSERTS

Unprotected condenser tubes most often fail at the inlet end; the section most vulnerable to pitting and thinning. The John Crane Condenser Tube Insert *armors* the belled mouth and entrance section of the tube—*completely eliminates inlet end air erosion and sand abrasion;* helps to prevent outages.

These Inserts are molded of a *hard, wear-resistant* bakelite material, unaffected by temperatures to 275° F. and resistant to contaminated salt or fresh water. Installation is easy on old or new tubes: simply slip the Insert into place. Available for 5/8" and 3/4" 16 gauge, or 5/8", 3/4", 7/8" and 1" 18 gauge tubes.

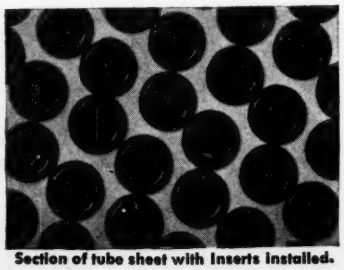


Insert in position. Flow is streamlined.

Service tests over a long period of time show that John Crane Condenser Tube Inserts

- **Greatly lengthen tube life**
- **Save critical metals**
- **Pay for themselves many times**

Send for illustrated bulletin, or consult our branch office nearest you for full information.

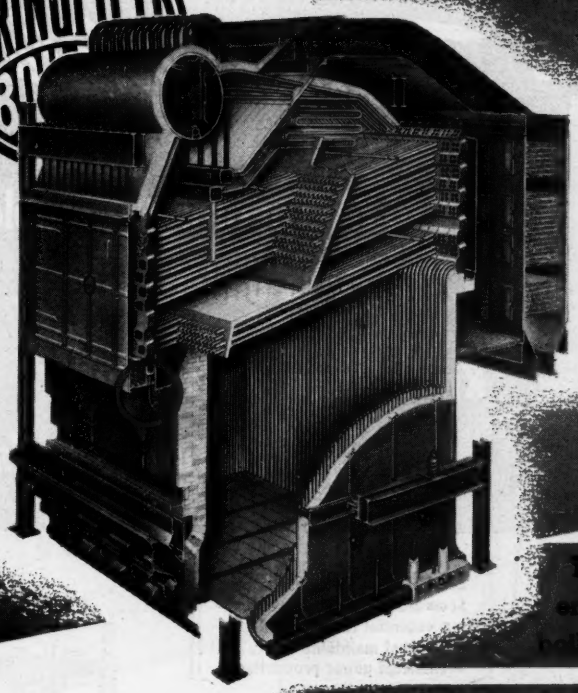


Section of tube sheet with Inserts installed.

CRANE PACKING COMPANY 1812 CUYLER AVE. • CHICAGO 13, ILL.

BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

CRANE PACKING CO., LTD., Hamilton, Ontario, Canada. Branches: Montreal, Toronto, Vancouver



SPRINGFIELD *Developments*

That Led to the Present Original and Modern Springfield Water Tube Boiler

The first continuous "high rating" operation was produced on Springfield boilers!

The first commercially successful water wall installation in America was made by Springfield!

The close spaced water wall was developed and first installed by Springfield!

The center wall divided furnace was developed and first successfully used by Springfield!

The staggered group tube arrangement was developed and its use extended by Springfield!

The production of better boiler headers by use of cast steel has been pioneered and developed by Springfield!

The first and only cast steel mud drum was developed by Springfield!

The modern application of cast electric steel headers for marine boilers has been developed exclusively by Springfield!

It stands to reason that it is wise buying to investigate the products of a company that has so consistently pioneered sound developments which have brought big advantages to boiler users.

We have no hesitation in saying "Compare a Springfield" point for point with any boiler. Write today.

SPRINGFIELD BOILER COMPANY
1951 E. Capitol Avenue
Springfield, Illinois

SPRINGFIELD BOILERS

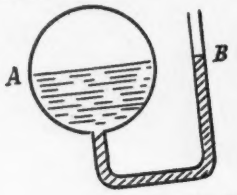
SPRINGFIELD
STEAM GENERATING UNITS
ANY SIZE—ANY FUEL—ANY PRESSURE

Let's double-check the *Fundamentals*

HYDROSTATICS 37

Manometers—*Differential Pressure*

The differential pressure manometer demonstrates the law of hydrostatics according to which liquid in a U-tube will show the surfaces at the same height in both vertical legs, if the pressures on the surfaces of the liquid in both legs are equal.

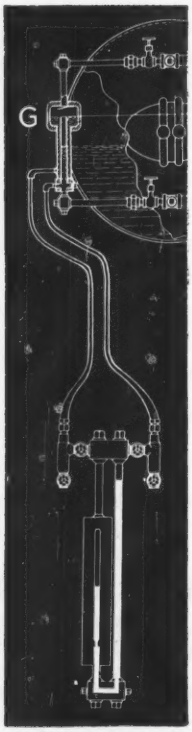


If pressure in one leg is greater than that in the other, the surfaces will be at different heights, the difference being proportional to the difference in the pressures and inversely proportional to the specific gravity of the liquid.

EYE-HYE operating principles easy to understand . . .

Knowledge worthwhile for your future planning

EYE-HYE's simplicity guarantees accurate boiler water level reading, essential to efficient supervision that maintains safety and economical power production.



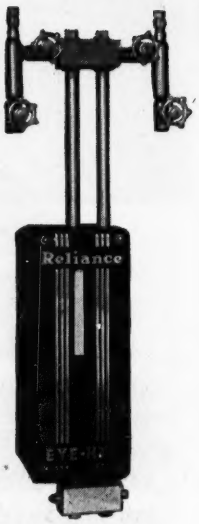
Reliance EYE-HYE operates on the principle of the U-tube manometer. EYE-HYE itself forms the bottom of the U, while the flexible tubes connecting it to the boiler drum complete the two legs.

Condensation of steam in the special reservoir known as the Unitemp (see G in diagram at left) maintains a level of water in one leg of the EYE-HYE hookup equal to the predetermined maximum *high* water level in your boiler. As water in the boiler drum rises or falls it exerts a varying pressure on the opposite leg. Unitemp also assures accuracy by equalizing the temperature—and therefore the specific gravity—of the water in both legs.

Counterbalancing these two pressures is a high specific gravity liquid known as Vizzene in the bottom of the U-tube. It is of a rich green color to provide an easily observed distinguishing indicator. Since this liquid will not mix with water, the water in the two legs pushes the Vizzene back and forth according to the difference in hydrostatic head pressure.

Thus the Vizzene is always in the same relative position between the two columns of water and becomes the visual indication of movement which gages the rise and fall of water level in the boiler with scientific accuracy. Each EYE-HYE is calibrated at the factory to suit your operating steam pressure (which determines the specific gravity of boiler water) and the vertical visibility of your boiler gage.

Write for Bulletin 382-C describing EYE-HYE models.

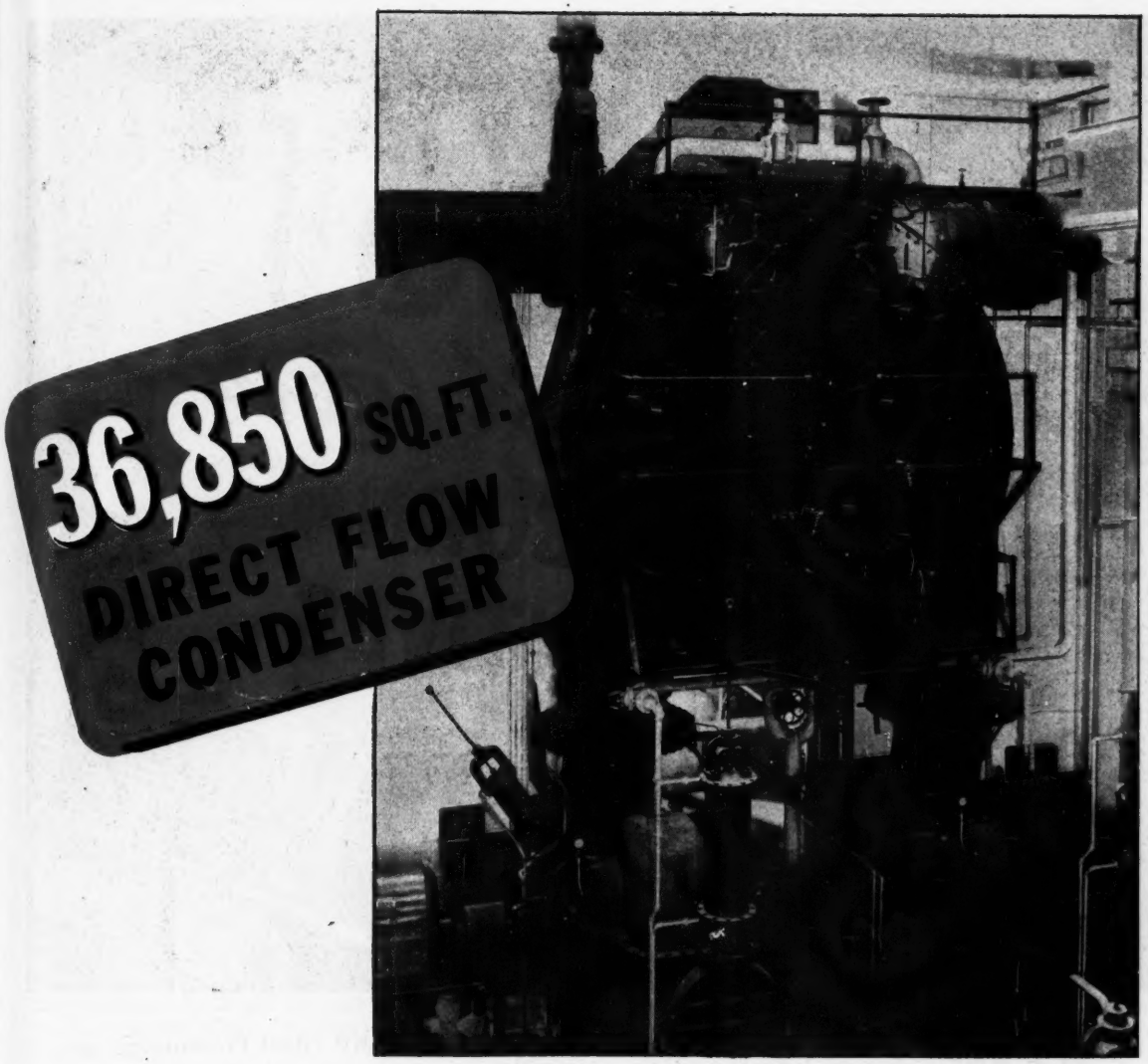


Model E-10
EYE-HYE

THE RELIANCE GAUGE COLUMN COMPANY
5902 CARNEGIE AVENUE, CLEVELAND 3, OHIO

BOILER SAFETY DEVICES since 1884

Reliance



THE recent extension to the Market Street Steam-Electric Station of the New Orleans Public Service, Inc., at New Orleans, includes a 37,500 KW turbo-generator and the two-pass, direct flow, divided waterbox condenser illustrated above. Cooling surface consists of condenser tubes 22 feet 3 inches long.

The two 30-inch horizontal circulating pumps shown in the foreground are of the double suction type, each having a capacity of 19,550 GPM.

Condenser and pumps were designed and built by Foster Wheeler.

FOSTER WHEELER CORPORATION

165 Broadway, New York 6, N. Y.

FOSTER FW WHEELER

RUST—a nuisance and a very costly menace in many plants no longer need be tolerated. Laboratory magic has furnished its master.

New Sinclair products, developed to solve tremendous military rust problems, are now available for your plant problem.

Sinclair RUST-O-LENE B for exposed metal surfaces of machinery in operation, in storage, or in transit

—provides a firmly-adhering rust proofing film
—prevents rusting of clean surfaces
—halts further rusting of corroded surfaces
—has lubricating qualities
—defies any degree of moisture from mere dampness to heavy rain
—can be readily removed when desired

Sinclair OPALINE RP (Rust Preventing) OILS for enclosed oil systems, prevent internal rusting of engines, hydraulic systems, gear reducers, and similar machinery intermittently operated, stored, or transported. OPALINE RP also has ample lubricating qualities for temporary use.

Both these remarkable Sinclair rust-preventives have successfully passed the most exacting service tests, and fully meet Government specifications.

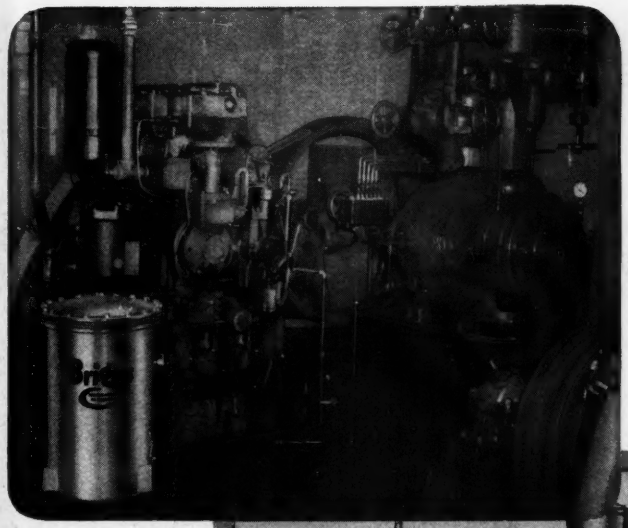
Learn how RUST-O-LENE B and OPALINE RP can combat rust for you. Write for brochure giving full details.

SINCLAIR INDUSTRIAL OILS

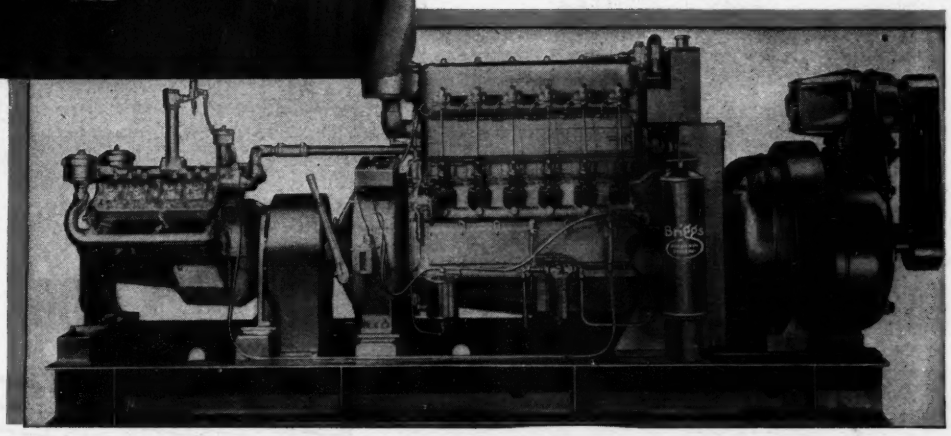
FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

POWER PROTECTION

for Diesel-Powered Compressors or Generators



D-3-AR-V5 Briggs Lube Oil Clarifier installed on Cummins Diesel driving compressor in ice plant.



G-800 Briggs Lube Oil Clarifier installed on Hill Diesel Generator Set.

WHY BRIGGS OIL CLARIFIERS PROVIDE *Better* OIL FILTRATION

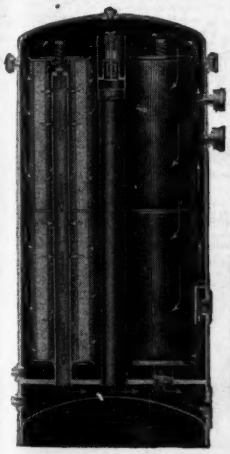
The Briggs method of oil filtration is based on nearly two decades of experience with problems of oil filtration . . . experience which developed the Briggs Patented Molded Fullers Earth Type Cartridge and more recently the DISCEL (All Cellulose) Cartridge.

THE FULLERS EARTH CARTRIDGE CLEANS OIL 3 TIMES—3 WAYS

FILTERS—Insoluble impurities . . . dust, dirt, metal chips . . . are *removed* by ABsorption through outer layer of cellulose.

PURIFIES—Soluble impurities . . . gums, acids, resins that cause corrosion and formation of engine-ruining sludge . . . are *removed* by ADsorption through Molded Fullers Earth . . . the same filtering medium used in the refining process.

CLARIFIES—Insoluble impurities smaller than 1 micron (.00004") are *removed* by ABsorption through inner layer of cellulose.



CUTAWAY OF BRIGGS D-8-BR LUBE OIL CLARIFIER

Construction and oil flow is typical of all Briggs Oil Clarifiers ... for fuel oil or lube oil ... for every type and size internal combustion engine.

Only Briggs Fullers Earth Cartridges give you this 3-TIME, 3-WAY removal of oil contaminants.

For effective filtration of additive-type oils—Briggs engineers have developed the DISCEL cartridge . . . scientifically designed to *remove* the maximum amount of abrasive impurities. This cartridge is made of specially-processed long fibered cellulose specifically for oil filtration. Its unique design permits removal of finer particles and provides greater dirt-holding capacity than is possible in any conventional cartridge design. It is interchangeable with Briggs Molded Fullers Earth Cartridge in all Briggs clarifiers.

GET THE BRIGGS FACTS

The Briggs Distributor in your locality can give you the complete story of the superiority of Briggs Oil Clarifiers . . . and back it up with performance facts that will be a revelation to you. Consult the "Where-To-Buy-It" Section of your phone book or write manufacturer for literature.

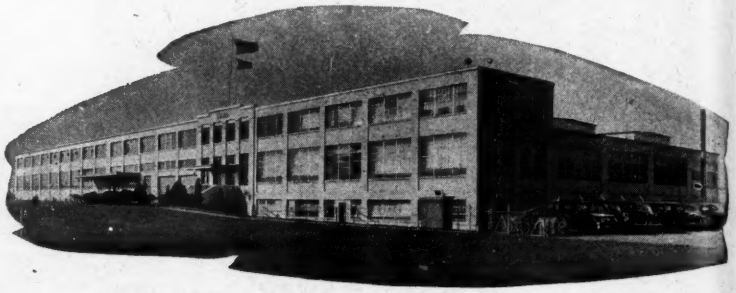
Briggs

PIONEERS IN MODERN OIL FILTRATION

BRIGGS CLARIFIER COMPANY
GENERAL OFFICES—WASHINGTON 7, D. C.
Distributors in Principal Cities

Boiler Capacity Up . . . Fuel Cost Down

WHIPPLE JACOBS, *President*
Belden Manufacturing Company



Exterior view of the Belden Manufacturing Company, Richmond, Indiana, well known makers of insulated copper wire, cable and cordage.

IRON FIREMAN STOKER Saves Over $3000 a Year at Belden Manufacturing Co.

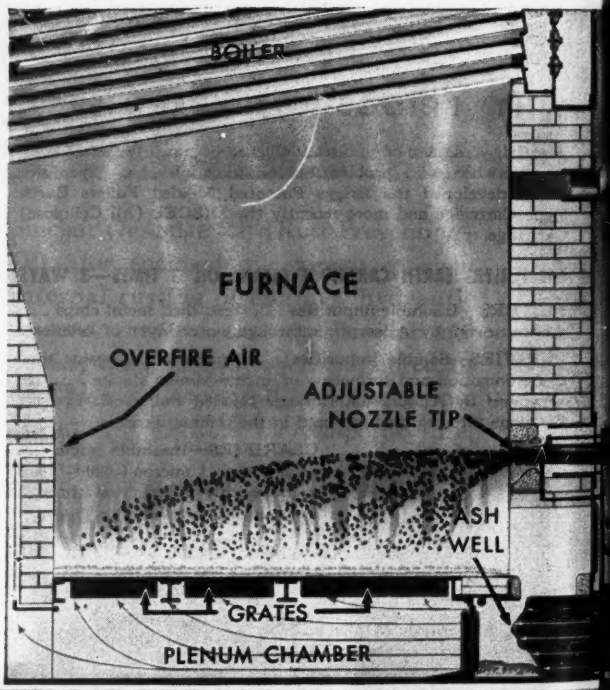
★ "In addition to providing a required increase in the capacity of our old boilers, we have reduced operating costs by $3,293 annually," reports D. D. McQuiston of the Engineering Department of Belden Manufacturing Company.

The Iron Fireman Pneumatic Spreader stoker model as used by Belden permits the use of local and lower cost coal, a vital advantage now when the transportation bottleneck presents serious difficulties. This greater efficiency and lower fuel costs are typical of thousands of war production plants that have changed to automatic coal firing.

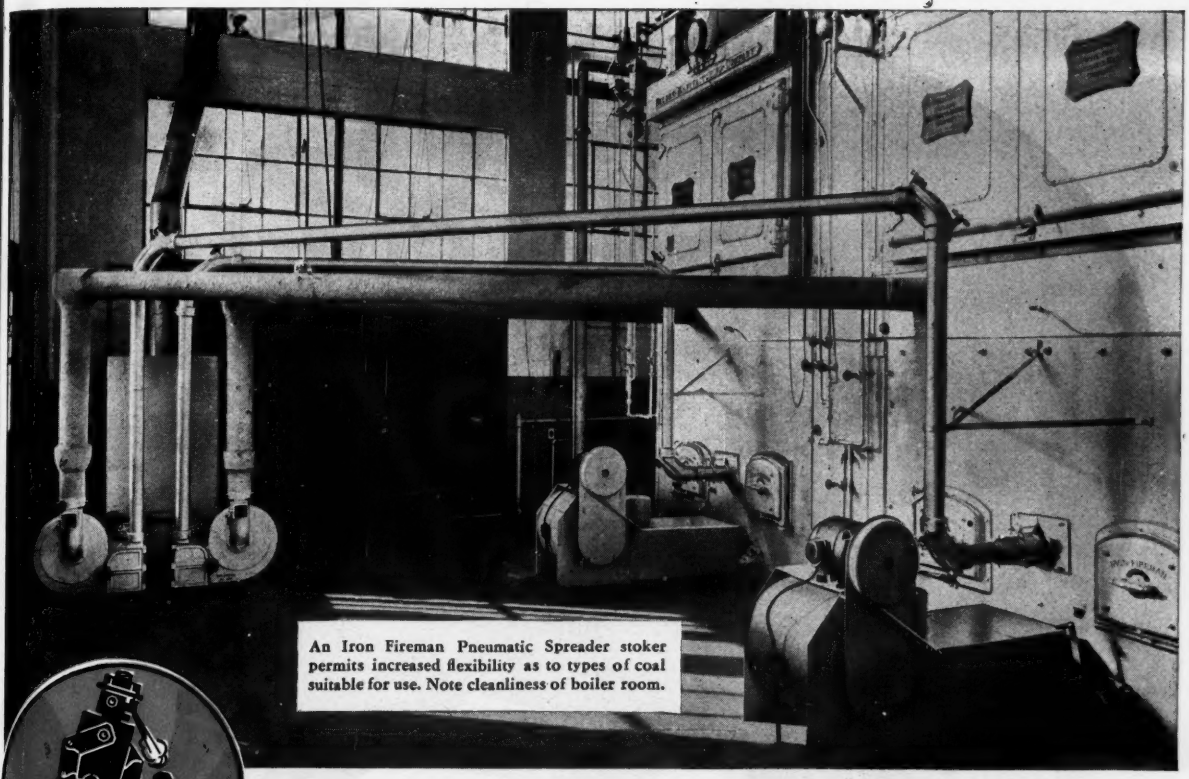
Convert to Automatic Coal Firing Now

No priorities are needed now for you to obtain the labor and fuel saving Iron Fireman Automatic Coal Stoker.

Phone, wire or write Iron Fireman Manufacturing Company, 3846 West 106th Street, Cleveland, Ohio.



IRON FIREMAN
THE IRON FIREMAN
TRADE MARK REG. U. S. PAT. OFF.
Automatic Coal Stokers

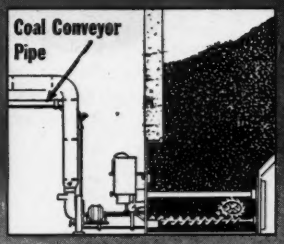


An Iron Fireman Pneumatic Spreader stoker permits increased flexibility as to types of coal suitable for use. Note cleanliness of boiler room.

THE IRON FIREMAN

BUNKER-FEED MODELS

Coal is conveyed automatically from the bunker to the boiler



PREHEATED AIR PIPE

Coal Conveying Pipe

COAL HOPPER

Nozzle Adjuster

Coal Nozzle

Forced Draft Fan Motor

Transfer Housing and Conveyor Fan Housing

Connection for Combustion Control

Conveyor Fan Motor

Worm Housing Cleanout

Feed Worm

Coal Feed Motor

Transmission

FORCED DRAFT FAN

FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3846 W. 106th Street, Cleveland, Ohio.

DUAL PROTECTION...

Although necessary only in emergencies—overspeed protection is important for safe turbine operation. On Westinghouse Type C Turbines . . . Dual Protection, a Westinghouse exclusive, provides maximum safety against overspeed.

Westinghouse Dual Protection acts upon the same valve as the governing mechanism—a valve which is in constant daily use. It also closes an independent butterfly valve . . . consequently, Dual Protection is always in position to function when needed.

This built-in plus value is typical of many you'll find in every Westinghouse Type C Turbine.

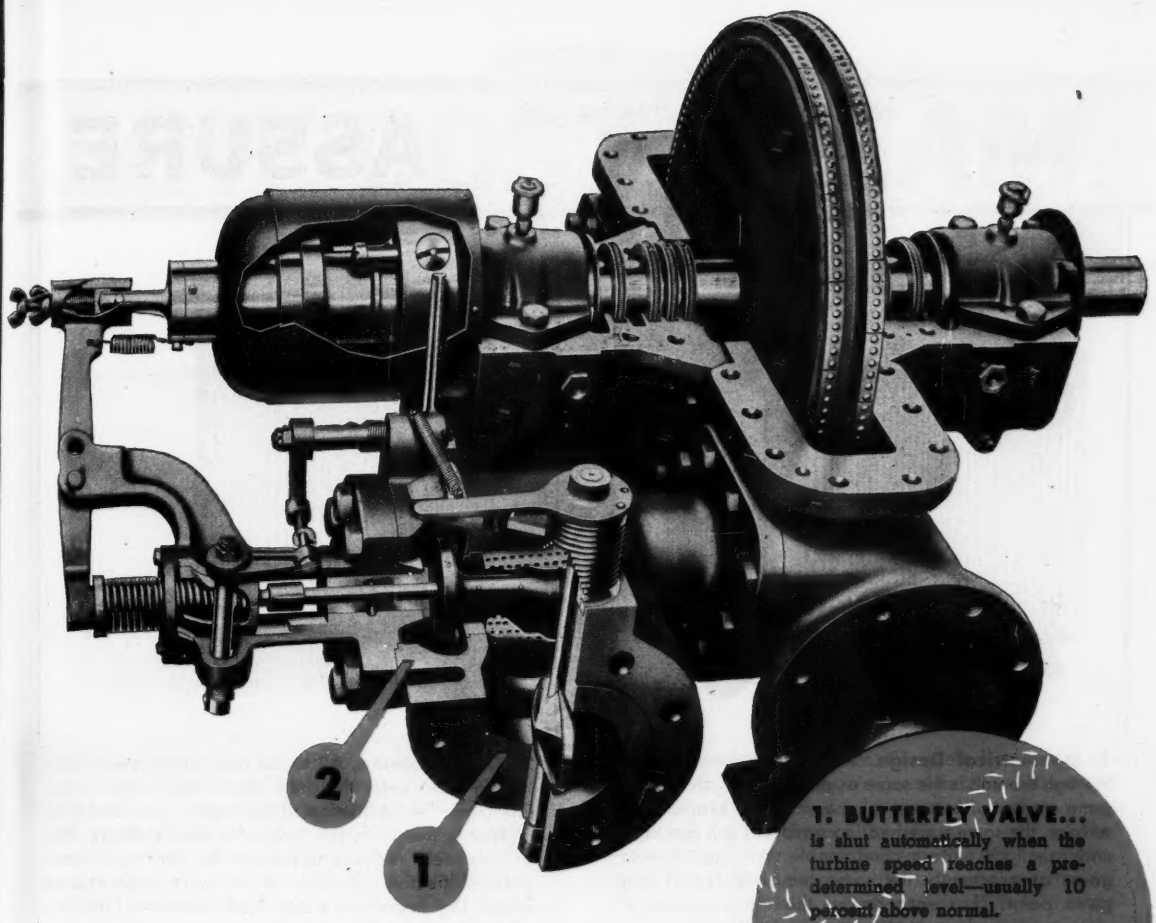
You get extra reliability, extra safety, extra economy in operation—and the use of steam drives may improve the heat balance of your entire plant.

Type C general-purpose mechanical drive turbines are built in five different sizes, covering a range of 5 to 1500 hp. The long list of proved-in-service installations includes pumps, forced and induced draft fans, pulverizers, compressors, Jordans, pulp beaters, lineshafts, generators—and many others. For complete information call your nearest Westinghouse representative. Westinghouse Electric & Manufacturing Company, Box 868, Pittsburgh 30, Pa.

J-50460

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE



1. BUTTERFLY VALVE... is shut automatically when the turbine speed reaches a predetermined level—usually 10 percent above normal.

2. GOVERNOR VALVE... is tripped simultaneously with the butterfly valve—giving positive assurance that the steam supply will be shut off.

...STOPS OVERSPEED

ON WESTINGHOUSE TYPE C TURBINES

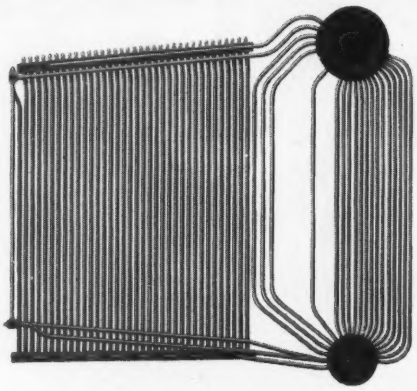
By making Dual Protection a *standard feature* of Type C Turbines, Westinghouse has made available to industry a degree of operating safety not previously obtainable.

During normal operation the speed of the Type C Turbine is controlled by the centrifugal weight governor—or by a regulator. If for any reason this control should fail, the overspeed trip device takes charge—simultaneously closing two valves, as shown above.

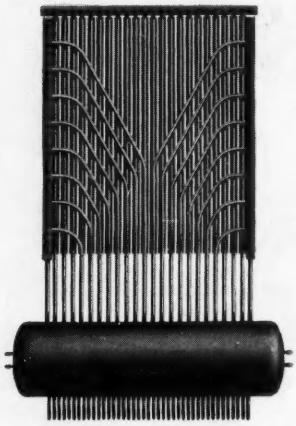
Steam Headquarters

WESTINGHOUSE

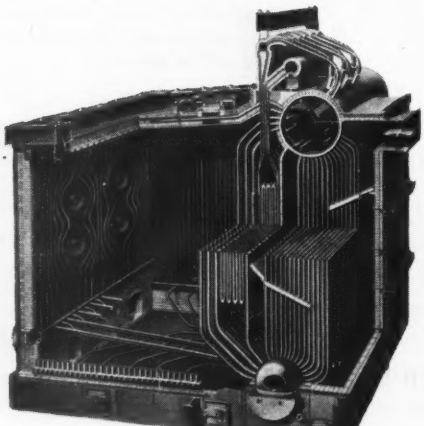
THESE 6 FEATURES ASSURE



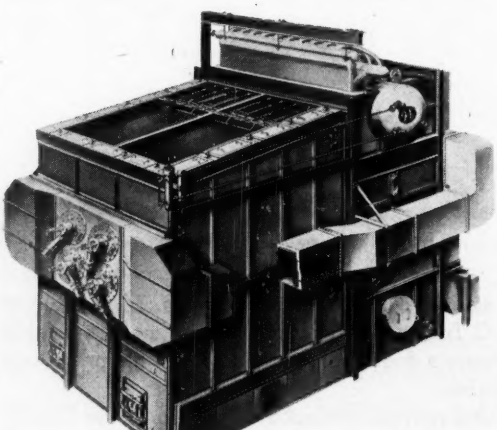
1. Symmetrical Design. Any longitudinal section through the unit is the same as any other. Each has the same amount of furnace volume, the same evaporative surface, the same superheating surface. Each functions under similarly uniform conditions — same mass flow of gases at practically the same temperatures at any given point. Thus each carries the same amount of water and produces the same amount of steam.



2. Quality Steam. All of the most active steam producing tubes enter the drum above the normal water line (refer to illustration at the right) and discharge uniformly across its full length as shown above. This arrangement reduces turbulence to a minimum and permits effective utilization of the entire steam release space. Dry steam and a stabilized water level are thus assured even under adverse conditions.

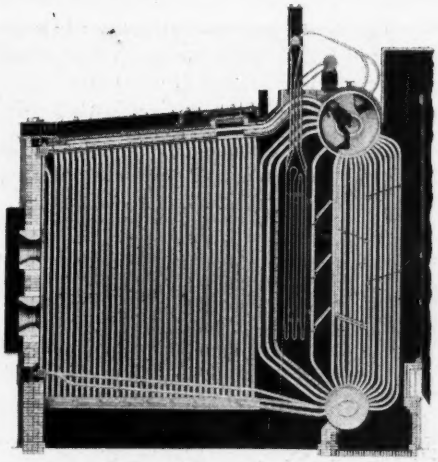


5. Adaptable in Application. The VU Unit may be fired by pulverized coal, oil, gas or any combination of these fuels. It is likewise readily adaptable to firing by any type of stoker. These units are suitable for widely varying requirements of load, pressure and temperature. Inclusion of an interbank or intertube superheater, an air heater or economizer is easily accomplished as conditions require.

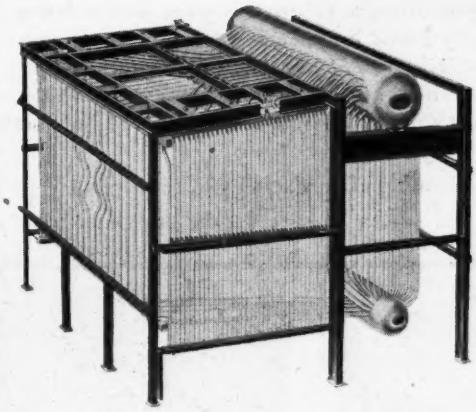


6. Steel Encased Setting. The unit setting of shaped tile, refractory and 100% insulation are attractively finished by a permanent outer steel casing. This design, evolved from careful study and experiment, reduces to a minimum heat losses caused by radiation and air infiltration. It tends to eliminate hot spots and helps maintain a uniformly low surface temperature throughout the steel casing. Maintenance is negligible.

LOW COST STEAM



3. Standardized Construction. Painstaking refinement of detail is incorporated in each unit at a fraction of the original engineering cost. With standard parts and structural features, the merits of which are confirmed by experience, manufacturing and erection costs are materially reduced. First cost reflects the economy of standardized design and the buyer gains this benefit even before his VU Unit is placed in operation.



4. Overhead Suspension. Complete freedom of expansion in all directions is assured because all parts of the unit are suspended from the steel structure which provides the framework for the steel casing. This feature makes ample provision for the effects of temperature changes; it eliminates abnormal mechanical stresses on all pressure parts and explains to a large degree the freedom of the VU Unit from leaky joints.

THE design and structural features illustrated and described on these pages are to a large degree responsible for the efficient combustion, consistent production of dry steam at all ratings, high thermal efficiency, reliable operation and low steam costs which have characterized the operation of the many VU Steam Generating Units now in service.

To medium sized and smaller plants these features bring many of the advantages of C-E's experience with high capacity, high pressure units plus the benefits of standardization. The VU Steam Generating Unit has an extremely broad range of application. It has been installed for capacities from 30,000 to 300,000 lb of steam per hr and for virtually all conditions of pressure and temperature. There are many VU installations fired with pulverized coal, oil, gas and combinations of these fuels; also many with stokers.

Compare its features with those of any similar equipment on the market. Evaluate them point for point. Then you will see why the VU Unit is so widely regarded as the best steam generator of its type offered by any manufacturer. A-848

FIGHT INFANTILE PARALYSIS

COMBUSTION ENGINEERING

200 Madison Avenue New York 16, N. Y.

C-E

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZER FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

AN INFORMATIVE BULLETIN

ON A NEW HEAT EXCHANGER DESIGN

The bulletin illustrated on this page is the latest literature by Davis Engineering Corporation on its new *Self-Cleaning Tubular Heat Exchanger.* It explains and illustrates graphically, in color, the design and operating principle of this Paracoil Tubular Heat Exchanger.

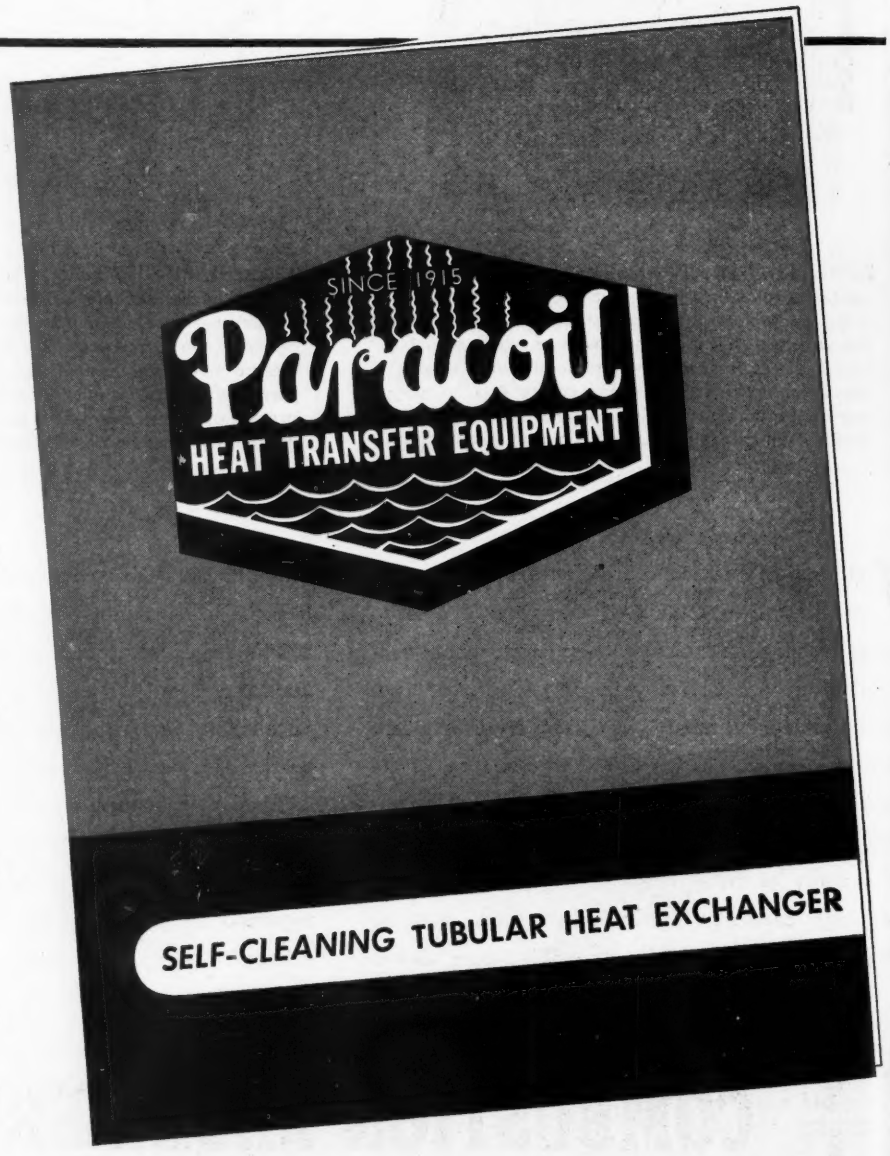
The Self-Cleaning Heat Exchanger, however, is but one of several standard and special Paracoil Heat Exchanger designs adaptable to many heat exchange operations throughout industry. If your plant has a special heat exchange problem, we invite you to consult us.

For special heat exchange applications, engineers and operating men are referred to the bulletin shown below. Ask for Bulletin HE-100.

Paracoil

HEAT EXCHANGE EQUIPMENT

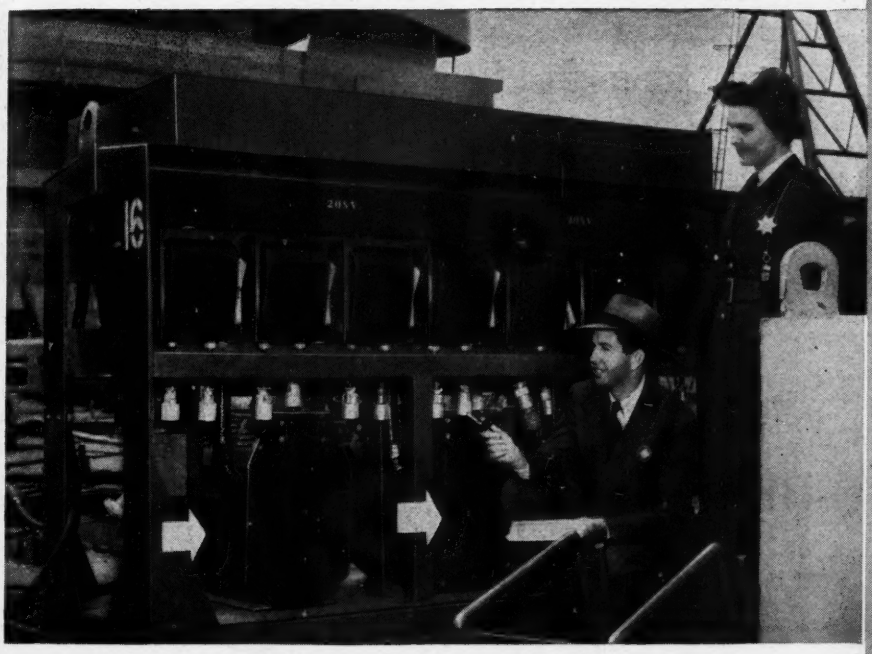
BLOWDOWN EXCHANGERS
BOILERS
exhaust gas—waste heat
CONDENSERS
CONVERTORS
COOLERS
condensate—jacket water—lubricating oil—quenching oil—solution
DISTILLING PLANTS
EVAPORATORS
EXCHANGERS
liquid to liquid—liquid to gas—solution
EXTRACTORS
grease—boiler feed water
HEATERS
instantaneous—feed water—solution — fuel oil — storage water
TRAPS
steam
VALVES
cross and three-way—exhaust gas by-pass



DAVIS ENGINEERING CORPORATION 1068 EAST GRAND ST., ELIZABETH 4, N. J.

SEE HOW THIS COMPANY BROUGHT THE RIGHT VOLTAGE TO THE JOB

SHOWS VERSATILITY OF SMALL G-E DRY-TYPE TRANSFORMERS



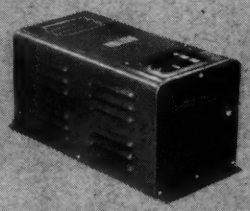
The unique sling-mounted power supply shown above was fabricated by the Permanente Metals Corporation, Richmond, Calif., Shipyard No. 2. As many as three of these units are placed at strategic points on the upper deck of a ship abuilding to provide a convenient source of power for portable blowers, tools, and lighting. They operate from a nominal 480-volt, three-phase supply.

Each unit consists of three G-E single-phase, 25-kva, dry-type transformers which form a three-phase bank, connected delta primary and wye secondary. This hook-up steps down the 480-volt supply to 208 volts three-phase, or 120 volts, line-to-neutral, single-phase—a time-saving application of in-stock, standard transformers to perform a special job.

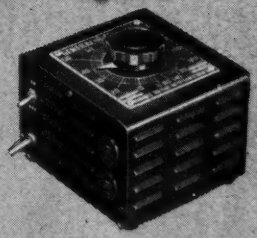
These transformers (Type D) are of the same construction being used, profitably, from coast-to-coast on secondary circuits in industrial plants. They provide the right voltage for the most economical operation of a wide variety of electric equipment. As they don't require fireproof vaults, they can be installed right next to the load, thus avoiding long runs of expensive copper. Their small size, light weight, and compactness make them easy to install on the floor, on the wall—anywhere you wish.

They are available in ratings up to and including 100 kva, 600 volts and below. For further information, ask for Bulletin GEA-897. *General Electric Company, Schenectady 5, N. Y.*

OTHER G-E AIDS TO BETTER VOLTAGE



VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.



VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.

AIR-COOLED REGULATORS—Automatic type: for secondary circuits (10% regulation, raise and lower). Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts.

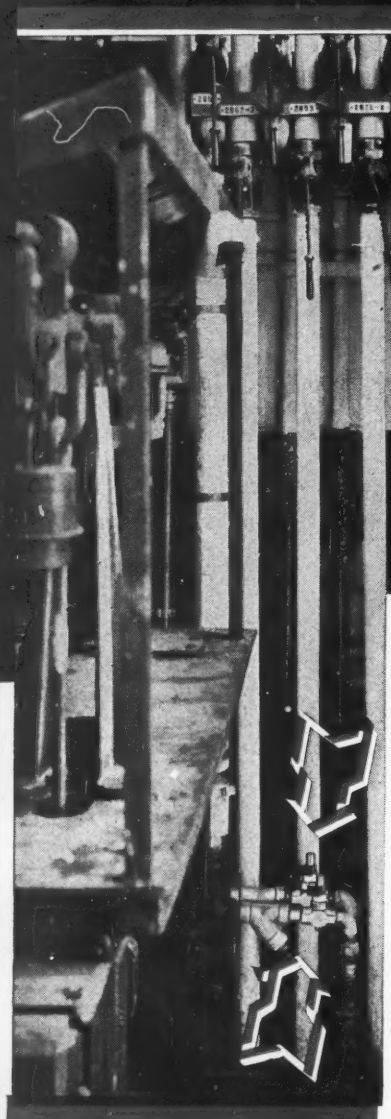
A FEW OF THE MANY PURPOSES FOR WHICH YOU CAN USE TYPE D TRANSFORMERS TO ADVANTAGE:

- To insulate lighting circuits from power circuits
- To boost low line voltage to improve equipment performance
- To reduce light flicker caused by motor starting, etc.
- To supply correct voltage for the most efficient operation of motors, machine tools, welding apparatus, etc.

THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB BETTER

GENERAL ELECTRIC

"We Shellacked the Condensate Problem with YARWAY IMPULSE TRAPS"



40 YARWAYS Serve Ault & Wiborg Co.

... Leading Manufacturer of Industrial Varnishes

"Whenever we use a trap, it's a Yarway. They're so compact we can squeeze them in most anywhere. We put Yarways on our jacketed kettles, unit heaters and tracer lines—then forget them. The maintenance in four years has been nothing."

So writes Mr. Keethler, Plant Superintendent, and his experience is typical of many users of over 350,000 Yarways in plants of all types from coast to coast.

The reasons for this satisfaction are simple and basic. Yarways have but one moving part, a simple valve . . . no floats, buckets, bellows, or diaphragms. The trap body is machined from cold rolled steel bar stock . . . rugged, built to *l-a-s-t*. As to size, Mr. Keethler has expressed it perfectly, "We can squeeze them in most anywhere."

When Yarways are installed, equipment gets hotter sooner and *stays* hot . . . has greater sustained heating efficiency. This is because when the condensate load is heavy, Yarways discharge continuously until the lines and jackets are cleared. Then, when equipment reaches the *working temperature* the discharge is intermittent, keeping it at peak performance.

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YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

One Hundred Miles from Pak Hoi

By GEORGE A. BENSON

ONE INCH outside our front door was the curb of a cobblestone street. It wasn't as wide as two ordinary sidewalks; not wide enough for an American automobile. It amounted to a tolerably wide, cobblestone walk between buildings. Such were the thoroughfares of Kwei Hsien. Traffic on them consisted largely of people walking, usually carrying burdens.

One open space in the squat and crowded town was the market place. My southern American up-bringing made me think of it as Court House Square but it was really an open air market for farm produce, surrounded by shops. Please don't think of concrete walks and drives with street lights, plate glass showwindows and displays of merchandise. There was nothing of the kind.

Kwei Hsien, the principal town of its district in Kwangsi Province, China, had 60,000 population, but covered no more acres than Searcy, Arkansas, where I live now, which has less than 3,000 people. Kwei Hsien was inland 500 miles up West River from Canton. The closest seaport was Pak Hoi, 100 miles overland to the south.

After renting some rooms and opening some boxes, my first trip down town was for kerosene. The oil store had been "out" for days, but now the coolies were coming into town from Pak Hoi with a fresh supply, and our lamp needed filling.

Tired was not the word to describe those sweaty, brawny, young coolies. They were exhausted. They had walked for ten days over an uneven trail from port, covering about ten miles a day. Each yellow workman had carried 10 gal of kerosene the full distance; one 5-gal tin swinging by a cord from each end of a bamboo pole which lay across his callous shoulders.

The local oil dealer was paying off his carriers when I came in, and the tariff was no secret. These men expected to get, and actually received, the equivalent of 10 cents a day for their work. At first I felt a twinge of anger toward the merchant, offering such paltry pay for such arduous work. Then I priced the oil and found that 10 cents a gallon had been added to cover the cost of coolie transportation from port.

This incident led me into more serious research. It made me hunt for economic factors that controlled industries more basic than oil, as far as China is concerned; agriculture, for example. More than 80 per cent of China's 423,000,000 people live on farms and work the soil, but year after year China imports more food stuff than it exports—much more. The nation can't feed itself, although there is no richer soil on earth.

Less than 20 per cent of the 132,000,000 people in the United States live on farms and work the soil, but, for some reason, America exports vastly more food than it imports year after year.

China's interior had a civilization before the year one. America was a jungle long after Christopher Columbus was laid to rest. Now, 500 years from start, America's interior has railroads and tank cars and moves kerosene 200 miles a day for one cent a gallon, but the Chinese still lug their oil on the end of a stick 100 miles in ten days at 10 cents a gallon. Chinese coolies draw a dime a day and walk; American railroaders get $8.50 a day and ride.

How is it that in America we pay such high wages to everybody who works, get so much better and faster service and yet obtain it at a mere fraction of the cost paid in other lands?

Was it because China was an old country; worn out? Could it be because China's land was eroded away, its forests hewn down, its coal and iron and oil exhausted? The answer was always, "No." China's soil is fertile and well-watered. There are forests, untouched veins of ore, unexploited and (in some cases) tested oil land. China has everything and does nothing about it.

Was it because the Chinese people were poor and stupid and lacking in ambition? Again, "No." The Chinese are naturally as smart as anybody. Some of them have proved their business ability by building fortunes in other countries.

There are great opportunities in China and the people who live there see these opportunities and let them pass. Why? Simply because they don't dare invest their money in anything. The economic system is such that both bandits and government rob business. Capital hasn't got a chance. Under the local war-lords, whose tenure is by force, it is a government of grab.

Capitalists in the United States have invested sums in railroads that add up to $25,000 per railroad employee. Consequently our railroaders ride at work and live well at home.

With big investments in rolling stock, road bed, terminals, etc., the American workman is able to move such a quantity of freight at such high speed that he can earn good wages in spite of low rates. Had the American workman only a 10-cent investment, such as the coolie, he could accomplish and earn no more.

In America we have an average investment in tools of $3,000 per farmer. Counting the value of the land, farm investment averages $6,000 per farmer. With good tools, each workman of the soil cultivates 50 to 400 acres. He can't eat up a modicum of what he raises. The surplus is exchanged for improved equipment and learning; for automobiles, refrigerators and radios; for dress suits, jewelry and oriental rugs that a Chinese family spent their lives weaving.

American workmen produce twice as much per man-hour as English workmen, three times as much as Continental European laborers and six times as much as Russian workmen. The important question is: Why do American workmen produce twice as much, get paid two-to-one, and live twice as well as English workmen or Germans; six times as well as Russian workmen? Capital investment is the determining factor.

The average cash investment for each American worker in industry is $6,000. This investment provides, on the average, 6 hp of installed and motivated, mechanical equipment for each employee to use. It is this capital investment which makes the higher man-hour production possible and justifies the correspondingly higher pay and higher standard of living.

Under the American system, labor benefits more from the capitalist's investment in industry than does the capitalist himself. In other words, capital is labor's benefactor—a friend without which American labor would be living on European standards—without which all labor would be living on the standards of China.

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THE SHAPE OF POWER

THE SHAPE of Power Engineering to come depends on how far ahead we look, how we define tomorrow. Barring the sudden and dramatic discovery of means of unlocking atomic energy directly—and we should not be too skeptical of that—our present knowledge is going to lead us to new methods in steam and power generation. Power engineers have seen the curves of efficiencies go up continuously for 40 yr and now they see them beginning to level off. It might seem as though we have nearly reached the limits of possible efficiency with our present power cycles. But many power engineers are beginning to wonder if we have yet applied to the full all the knowledge we have gained in the past two decades. They recognize also that much of our war-time knowledge is still restricted and may produce changes in our thinking when released.

Looking only at the immediate future of power engineering—the first three or five or ten years after the war—it is true that the shape of power engineering will not be much different from what it was just before the war. To keep our industries running continuously and efficiently right after the war, we must make our power plans on the basis of the methods we know today, since it takes as much as two or three years to design and build power plants.

Developments during the war, however, have given us hints of possibilities for advancement.

Improved Steam Cycles

It is significant that in the condensing steam cycle, the highest thermal efficiencies, given as 32-34 per cent, now attained in condensing steam plants, have been attained in cycles employing reheat. Some engineers, however, believe the full possibilities of the reheat cycle have not yet been explored. Preliminary studies indicate that by using only the relatively low temperatures and equipment now available but with some rather radical modifications in the cycle itself, thermal efficiencies could be raised considerably by new reheat cycles.

Another idea recently proposed for steam cycle improvement is shown in Fig. 8. This is the super-regenerative cycle of J. F. Field. It employs a nearly reversible cycle with multiple regeneration up to the maximum operating temperature. The physical arrangement would employ a specially built turbine, with front end blading deeper and low-pressure blading and condenser smaller than at present, with multiple regenerative heating in stops of 100 F, a direct-fired high pressure superheater, a compressor and an air preheater. It could be applied to existing plants, says the designer, would give an increase in capacity and efficiency over the ordinary back-pressure plant at moderate temperatures and would compare favorably with the Diesel for ship propulsion. Practically any kind of fuel can be used as against the necessity of oil or gas for the gas turbine and expensive light oil for the Diesel.

The designer calculates actual or yearly thermal efficiency of the super-regenerative cycle at 35-38 per cent for an initial temperature of 850 F; 37-40 per cent for 950 F; 38-41 per cent for 1000 F; 40-43.5 per cent for 1200 F.

The Gas Turbine

The gas turbine, too, is bound to shape the power engineering of the future. It will come in stationary practice, though not at once. It is already here in transportation and military use, along with jet propulsion and the rocket. Its proponents are anxious to see it develop only on a sound engineering and economic basis. For the stationary power plant, its use will depend principally on the adaptation to it of solid fuels. For the immediate present, the utility industry will not be its prime application, despite the possibility of efficiencies of 15-16 per cent with the simplest open cycle gas turbine at 1000 F and efficiencies of the order of 30-35 per cent with more complex closed cycle units. Questions of part load efficiency, control, construction costs, use of the utility's basic fuel, coal, and dollar efficiency will govern here.

The versatility of the gas turbine in fitting into industrial heat balances may lead to many more applications in that field, where it must cope with the demand for process steam and other plant services. For steam making, one proponent of the gas turbine points out that it makes available about 75 lb of hot gas at 600-900 F per kilowatthour of power developed and by the use of waste heat boilers or heat exchangers of compact modern design can fit well into industrial heat balances. Where liquid by-product fuels or large quantities of gas are involved in the processes, the gas turbine will find applications similar to those now found in the Houdry process.

A recent development is a design of gas turbine with blades cooled by a portion of the air compressed in the cycle. Thus a fairly simple gas turbine cycle can be used with materials now available to utilize an inlet gas temperature of 1500 F and to secure at once, without much complication, thermal efficiencies between the order of 24 and 37 per cent.

Data for gas turbine efficiencies for various open and closed cycles, ranging all the way from 15 per cent for simple open cycles to 35-45 per cent for large closed-cycle units have previously been given in these columns, notably in the February, March, April, May and June issues.

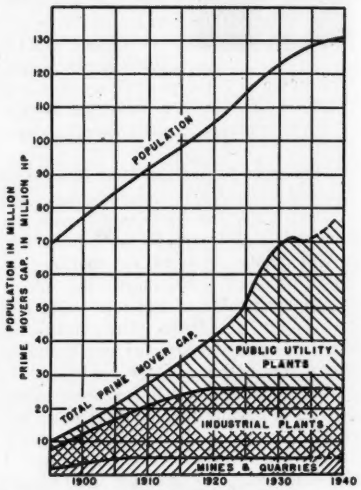

Fig. 2. Growth of prime power for domestic and industrial use compared with the growth in population of the United States

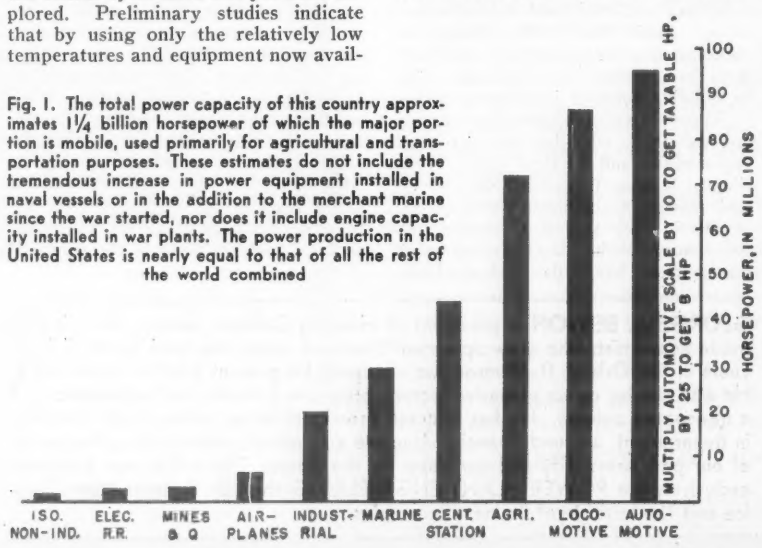

Fig. 1. The total power capacity of this country approximates 1¼ billion horsepower of which the major portion is mobile, used primarily for agricultural and transportation purposes. These estimates do not include the tremendous increase in power equipment installed in naval vessels or in the addition to the merchant marine since the war started, nor does it include engine capacity installed in war plants. The power production in the United States is nearly equal to that of all the rest of the world combined

ENGINEERING TO COME

Developments in the gas turbine will naturally be related to the fuel problem. Some engineers believe that it might pay to work on processes for producing ash-free liquids directly from coal for gas turbine fuels, so that we may go ahead rapidly with the turbine development. Gas turbine progress is related to developments in high temperature metals and has, in fact, led the way in these developments. Many of the metallurgical facts learned in gas turbine work can also be applied in the steam field.

High Temperatures

Experience during the war with very high temperatures in the steam cycle includes the use of separately-fired superheaters constructed mostly of 18-8 chrome-nickel alloy steel for producing process steam at 25 psi and 1400 F and the use of boilers in marine practice with separately-fired superheater furnaces. Use of this type of furnace in stationary practice has been limited to several very large units. When this type of unit becomes readily available in smaller sizes, after the war, it may affect our thinking about control of steam temperature, even in the moderate-temperature ranges.

Much progress is being made in the metallurgy of power plant materials. The problem of graphitization of steel piping is being attacked vigorously and when solved will enable piping costs to be kept down without use of expensive alloys. However, there are designers who believe it perfectly feasible and economical today to design power plants for operation at 1000 F. One recent design study showed the most economical plant to be a 1600-psi, 1000-F unit.

Designers are giving considerable thought to simplification and shortening of the highest temperature piping, so that even if special steels do have to be used, such as chrome-nickel, their high cost can be justified. The plant of Fig. 8 shows a construction not unlike that of the old locomobile engine and boiler plant. Compression cannot be carried too far, naturally, for space for tube-drawing, disassembling and maintenance must be provided.

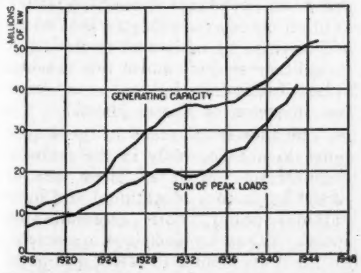

Fig. 3. Generating capacity and peak loads of all electric power plants contributing to the public supply
Source: EEI and FPC; presented by A. D. Bailey, POWER PLANT ENGINEERING, June, 1944

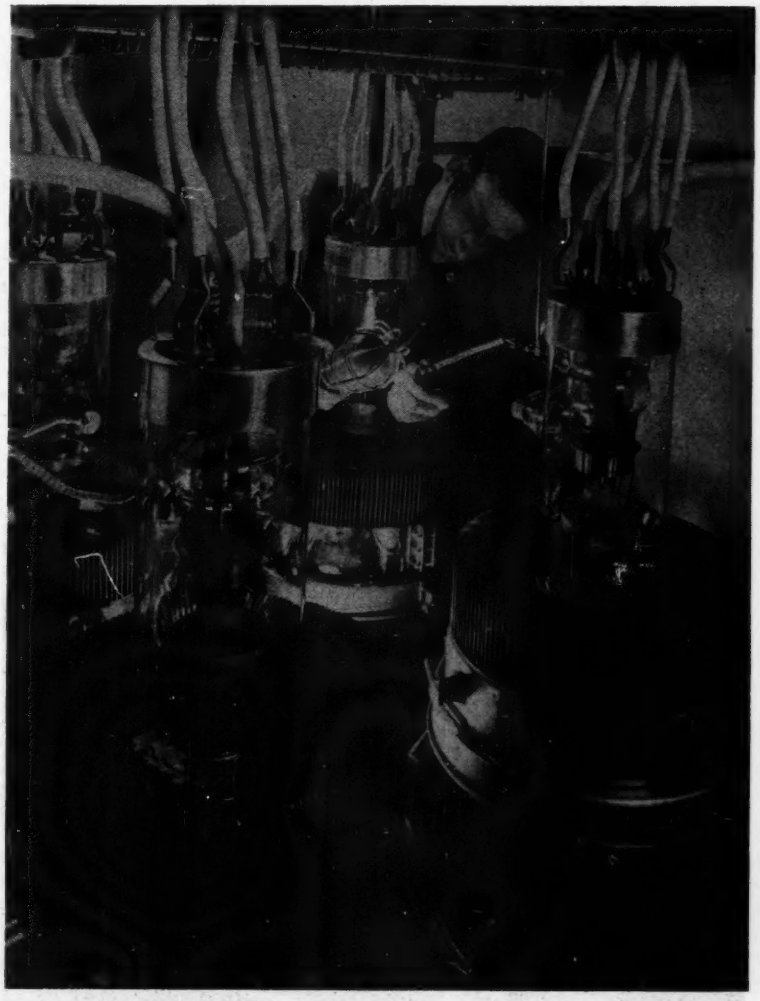

Fig. 4. Fifty thousand watt high vacuum tubes installed in Westinghouse Station KDKA

Power Trains and Portable Plants

For rapid modernization of industrial plants, for certain very special utility conditions, the package and semi-portable plants may have many advantages in ability to operate with low-grade fuels and poor water and thus take advantage of regional factors. The power train will be of interest to utilities, for it can serve as a power supply on systems where the load in certain regions is known or expected to be of a rapidly changing character, for it can be readily moved to other locations as conditions change. Previous uses of the floating power plant, the use of locomotives for temporary steam supply and similar experiences in past years are good illustrations of possible future power train applications. For some seasonal industries it may also have application.

Whether the mercury plant will appear in smaller sizes, say 5000 or 10,000 kw, in the future and find application in utility systems for supplying both steam and power to industrials, is another interesting speculation for the future.

Steam Generation and Combustion

Turning to specific equipment, engineers may expect to see extension of the forced-circulation boiler idea, especially in the moderate sizes. It is perfectly true that for all practical purposes the problems of natural circulation, even in the largest units, have been successfully overcome. But to some engineers, at least, the forced-circulation boiler has also proved itself and may permit compact arrangement of heating surfaces and heat absorption factors that make it worth further study.

Interest is also keen in the possibilities of further improvements in combustion equipment. These are required by necessity for further cost reductions

and by the possibility of more stringent smoke ordinances. An experiment is now under way in burning a high-ash crushed coal in suspension, without pulverizing, in an attempt to improve the handling of ash and slag. A new method of pulverizing coal and other materials, without the use of a rotating mechanical pulverizer, is also being investigated.

Future fuel situation will make it important to design more equipment for burning multiple or alternate fuels. Interest is growing also in the design and operation of furnaces under pressure. At least one such installation is now being designed.

But most interesting of all is the possibility that pure oxygen in large quantities can be produced at relatively low cost in the future. Some study is being given to burning fuel with oxygen direct, rather than with the oxygen extracted from atmospheric air as at present. Such combustion would be as close to theoretical combustion as possible to attain. The flue gas from such combustion would have entirely different characteristics from that produced with air. Including calculations for cost of oxygen and possibly for combustion equipment, the economic possibilities of recovering practically pure CO_2 from this flue gas or of combining certain chemical or industrial processes with the combustion process are not being overlooked.

Perhaps from some of the current jet or rocket propulsion mechanisms will come some ideas for combustion of liquid or solid fuels in boiler furnaces.

Steam Turbines

There is still much debate on standardization of steam turbine sizes, especially those in sizes from 10,000 to 60,000 kw in capacity. In the November issue, C. B. Campbell presented a chart summarizing the ratings, inlet steam conditions and extraction conditions on which there is widespread agreement among a large group of engineers and manufacturers. It is hoped and believed by its proponents that such standardization, including many components of the units, will lead to quantity production, improved deliveries in complete units and general improvement in generating plant design and finally, reduced costs.

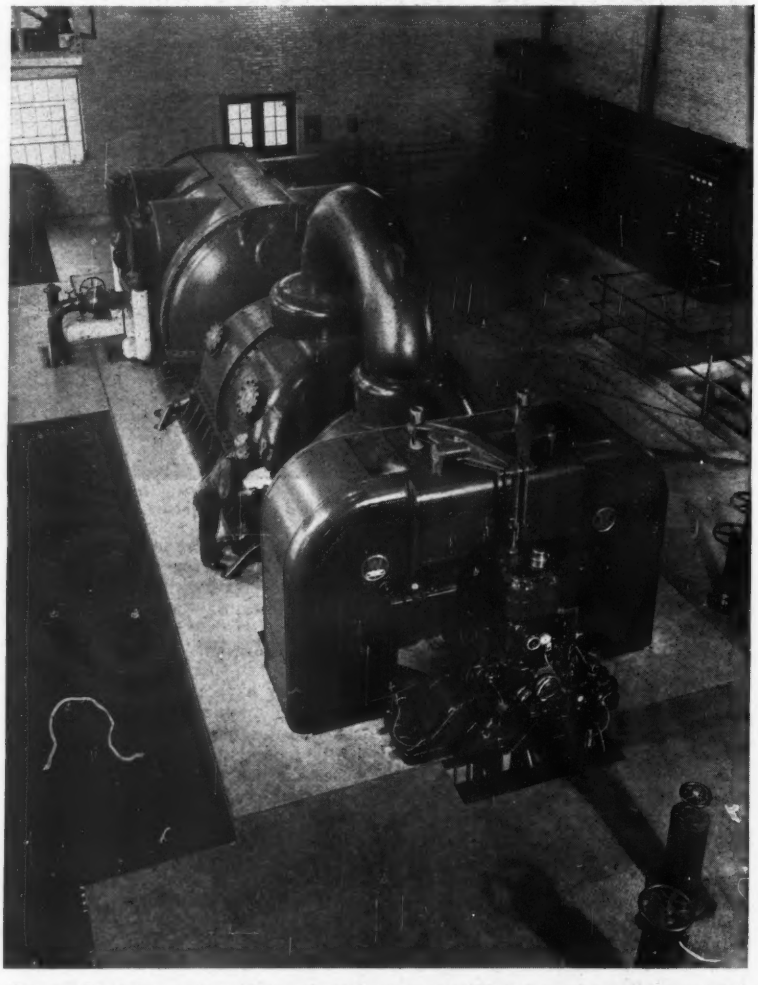

Fig. 5. Operating superposition and condensing, this 40,000 hp turbogenerator set uses steam at 1250 psi 900 F and may extract 50 per cent of its total steam at 230 psi (Photo, Westinghouse)

Internal Combustion Equipment

It is still too early to see how the developments in the internal combustion engine field will affect future power engineering. At present there is considerable concern over the rapid depletion of our existing oil reserves, although this is opposed by the opinions of at least one very competent authority. But there is much evidence that on this continent, at least, increased exploration is not discovering as much petroleum in the ground as formerly. If our future civilization is to depend for its personal transportation on the automobile, the private airplane, the helicopter, and other devices still to be developed, and if these are to be powered largely with gasoline or Diesel engines or some other form of internal combustion engine, using a fuel based on petroleum, then something radical may have to be done about their fuel supply.

Of the 1,250,000,000 hp of prime movers estimated to be in existence in this country, Fig. 1, most of it is in the form of gasoline or Diesel engines. For example, if there were 30,000,000 automobiles in use, each powered by an engine of 35 hp, there would be 1,050,000,000 hp in that item alone. Single airplane motors of about 2000 hp capacity are common. At the end of 1943, we are told, the U. S. Navy had installed 78,000,000 hp of which 52,000,000 was in Diesel engines, 44,000,000 hp in steam equipment. This is in addition to 30,000,000 hp of Diesel equipment and 30,000,000 hp of steam in the merchant marine service. Diesel power expanded rapidly during the war because of lack of facilities for manufacturing a sufficient quantity of steam equipment.

Many of our future developments, therefore, will depend on the relative costs and availability of our fuels. If we cannot discover enough oil in the ground in our own continent, can we import enough? Can we recover enough from our oil shales? Can we increase the efficiency of our gasoline and Diesel engines? Will it be necessary for us to produce synthetic motor fuels from our great stores of coal and natural gas, by processes now known, or develop new ones? Will it be possible by all these procedures to produce enough oil for all the Diesel engines we wish to operate? Or will that supply have to be restricted in order to produce enough gasoline? Will oil become so valuable that its use will have to be restricted to the Navy, to military aircraft and a few essential industries and forbidden as a power fuel in steam or Diesel plants?

The answers to many of these questions do not lie solely in the realm of engineering. Most of them are affected by factors of national and international policy, both economic and social. Whatever decisions are reached on them are bound to affect and be affected by, the power engineering developments of the future.

Engineers in the internal combustion engine field may be expected to

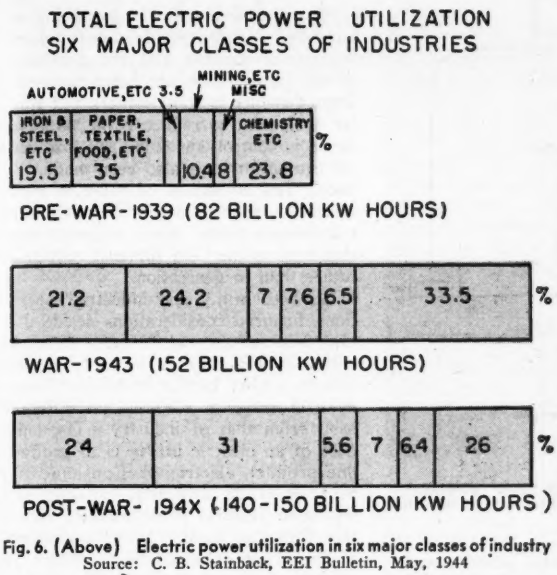

Fig. 6. (Above) Electric power utilization in six major classes of industry
Source: C. B. Stainback, EEI Bulletin, May, 1944

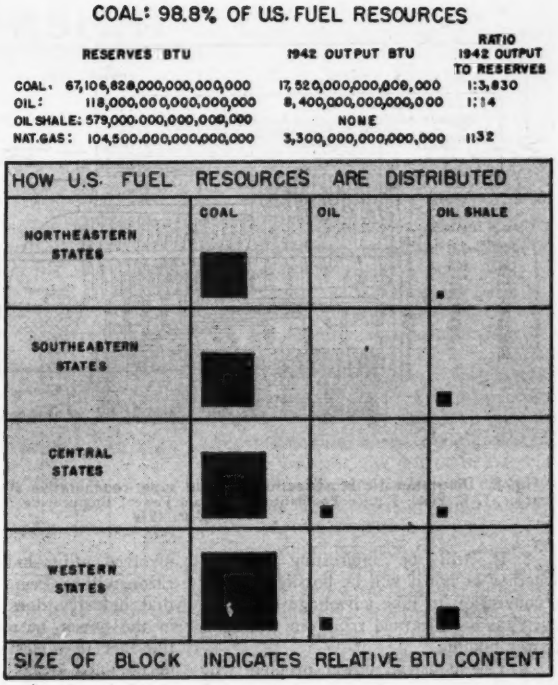

Fig. 7. (Right) Chart Showing Fuel Reserves of the United States
Source: Ralph A. Sherman, Fuels of the Future; Battelle Memorial Institute

produce ingenious solutions to the problem of further efficiency increases to stretch the oil supply.

Hydroelectric Power

Since efficiencies of hydroelectric generating units as high as 94 per cent have been reached, and there are many units operating at over 90 per cent efficiency, it might seem that further progress in the hydroelectric field would be too costly. Yet that seemed to be the case 20 years ago when efficiencies were already high and hydroelectric engineers expect that present values will be exceeded by further design improvements.

But most of the important commercial water power sites available to private utility companies have now been developed. Many engineers and laymen feel that further extension of hydro-electric power development will be mostly by co-ordinated development of entire watersheds.

The Immediate Future

TURNING NOW from the long-range view to the prospects that will follow the war immediately, let us consider now such factors as: 1. Reconversion of industry; 2. Dollar efficiency in postwar modernization; 3. Influence of fuel costs and availability on post-war modernization.

Reconversion Factors

Modernization and rehabilitation of the country's power facilities will be one of the first and most important tasks of reconversion. The volume of such planning now being done by consulting, utility and industrial engineers shows that many industries see this.

The power industry will be faced with the following conditions:

1. Reserve capacity is relatively low in the utility field as a result of the increased war load and the retardation of new construction to save time and critical materials. Figure 3 shows how our present electric power utility generating capacity, based on EEI and FPC data, compares with our peak loads for a number of years and how our reserve is lower than experienced utility operators like to have it.

Industrial reserve generating capacity, according to FPC surveys, increased from about 9,000,000 kw in 1939 to about 11,000,000 kw in 1944. But in 1939 peak loads were about 7,000,000 kw, whereas the added war load on industrial plants amounts to about 2,500,000 kw, leaving the margin of reserve lower than before. However, even if post-war reconservion results in an industrial activity 40 to 50 per cent greater than in 1939, as CED estimates, it is by no means certain that industrial power demands will drop to that value. Much the same situation will obtain as during conversion because production machinery will demand about the same installed generating capacity whether its products are civilian or military and because of the pent-up demands for consumers goods, may even demand more for a few years after the war.

2. Some of the new work done during the war will have to be remodeled because it was extemporized for the emergency.

3. Industrial power plants will need modernization in varying degrees. Essential and large power-using industries need least; some non-essential and service industries are in poor condition.

4. If reconversion of industry takes place over a long period, in bits and pieces, the utility industrial load may not drop at all, for the graduated shut-downs and pick-ups in various industries will be staggered. Even if reconversion is sharp, with a sudden cessation of war production in all industries at once, there will be benefits in that for many utilities in the opportunity to shut down large blocks of generating capacity for necessary maintenance work; the same will apply to many industrial plants.

5. Return to standard time in various sections of the country will at once add from 1,000,000 to 1,500,000 kw to the total demand capacity, without a corresponding increase in kilowatt-hour output. Cut-backs from 3-shift operations in industry may also affect the load.

6. It takes 2 to 3 years to build a large utility power plant from the time design is begun; somewhat less for smaller utility and industrial plants. Hence in both fields it is not too early now to begin planning for new construction.

7. Regional factors will have to be considered by many utilities. In some sections, war plants now furnishing heavy power loads cannot be converted and will have to be shut down; in others, they can be converted to civilian production and may even increase the load. Increase of farm uses of power in some regions may be of importance to utilities, while the increased load of industries supplying a long pent-up demand for civilian goods may be appreciable.

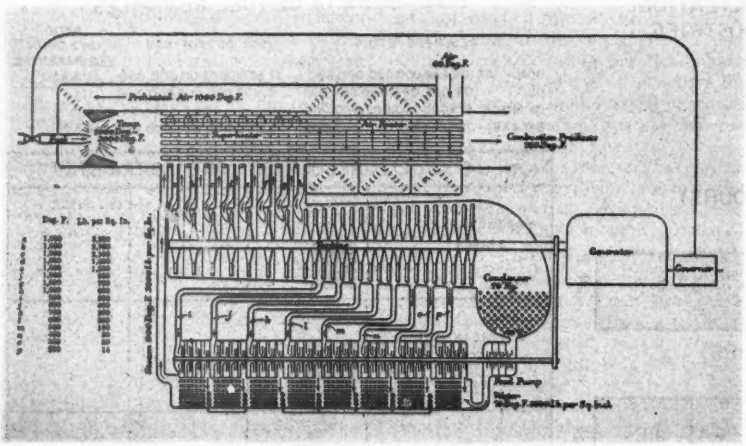

Fig. 8. Diagrammatic cross-section of Field super-regenerative steam cycle equipment
Source: J. F. Field, Future Possibilities of Steam Power; Engineering (London) via Combustion, September, 1944

8. It will be interesting to see whether or not it will be possible during reconversion to take advantage of whatever has been learned from our war-time power pooling.

9. The industrial power problem will be primarily one of modernization and replacement rather than of obtaining additional capacity. Many small and uneconomical plants will have available to them not only all the familiar and tested equipment they have been unable to secure during the war but a number of new refinements that may be useful in increasing their economy. There are too many wasteful, smoke-making small industrial and service plants. And they are ripe for a change.

10. Because of the economic factors involved, utility-industrial power competition will be keen, for, despite the fact that industry does not want to engage in the power business, it cannot ignore the fact that electric power may often be obtained from back-pressure and extraction turbines at very low cost. The utility industry, except in a few favorable cases, has not yet found ways to justify supplying steam and other power plant services to process industry. The principal justification for industrial power plants is to furnish a continuous supply of steam, compressed air, refrigeration, air conditioning, water and the like. Whether or not they should also generate power depends on those factors and on the relative power cost in terms of product cost.

How Costs Will Shape the Future

THE POWER industry will operate again in a world of economic rather than of military necessity. Before the war, utility costs were beginning to level off at a point below which further decreases were very difficult to attain. But the downward curve of costs, reflected in a decrease in the cost of power to the consumer, had been going on for many years, and the consumer has been accustomed to having this called to his attention. However, in the post-war period, the utilities expect that labor costs will be higher than before the war. They also expect that fuel costs will be somewhat higher than pre-war fuel costs, but lower than present costs. Simplification of design of new plants and extension of the use of automatic control seem to be two of the principal factors considered to effect further reductions in generating costs. If building construction costs remain high, there will be more interest in the semi-housed or unhoused plant.

Transmission costs also are being attacked by the utility industry. Increased loading of circuits and the possibility of d-c transmission are being discussed. Improvements in transformers and similar equipment to reduce costs, improvements in control, switching and load center equipment have also been made. By taking full advantage of these in modernization, reductions may be possible in transmission costs. Some engineers hold that here is the field for cost reduction, rather than in generation.

In both utility and industrial operations, financial considerations decide that capital investment can be made either to increase reliability or to increase efficiency. Utility capital investment, however, is made on a somewhat different basis from that of industry. The business of an electric utility is to produce one product, electricity. Consequently, because of its diversity, capacity use and load factors, some utilities figure that they can usually afford investment of the order of about $6 to secure $1 in return. On such a basis, the investment is paid back in 7 to 10 or 11 years, depending on interest rates.

A manufacturing industry, however, is much more subject to changes in the uses of its products, hence most industries try to secure return of capital investment by savings in a maximum of 5 years, with the average time being 3 to 3½ years. A survey of 100 leading industries some years ago showed that over half of them desired capital investment return in 3½ years, many in less than that and only a very small number in as much as 5 years. This means that only $2.50, $3 or $4 can be invested to earn a return of $1.

Industrial power engineers must always keep this fact in mind when showing industrialists how power modernization will benefit them. When old equipment fails to carry the load continuously or breaks down completely, industry cannot avoid instant action. But when improvements in efficiency or lowernig of costs by power modernization is argued and reliability is not at stake, industrial plant engineers often forget that they must justify them to management on the same basis as manufacturing equipment.

The minimum amount industry will invest for power equipment is that necessary to keep production going with no danger of shutdown. Beyond that, more efficiency must be justified by data to answer the question "How soon will the savings pay back the investment?"

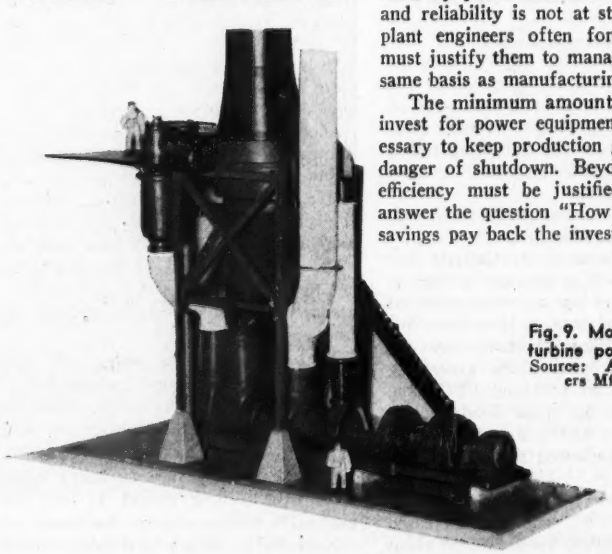

Fig. 9. Model of gas turbine power plant
Source: Allis-Chalmers Mfg. Co.

Fuel Influences Design

COAL will continue to be our basic source of energy for generation of steam and electric power. It is by far the most plentiful and the cheapest.

The tremendously accelerated demand for gasoline and other petroleum products during the war, the need for conversion of both domestic and industrial oil-burning plants to coal, the building of Big Inch and many other pipe lines for oil and gas and the general to-do over oil have caused engineers as well as laymen to become confused about the fuel situation.

Coal forms 98.8 per cent of our national fuel resources, Fig. 7; will be the basic source of our energy in the future on the basis of both cost and availability. If the present trends continue in the production and utilization of both oil and gas, a day may come relatively soon when somebody—the petroleum industry or the government, or both—may have to tell industry that oil must be restricted to the Navy, to production of liquid fuels for aircraft and a few essential civilian uses and that it is too valuable to be burned as a power plant fuel.

Fuel Resources

Various estimates have been made of the length of time our present known fuel resources will last us at present rates of consumption:

Bituminous Coal, high volatile	2400 years
Bituminous Coal, low volatile	360 years
Sub-bituminous coal	?
Lignite	?
Anthracite	150-175 years
Natural gas	30-75 years
Petroleum	12-15 years
Oil shale	60-70 years

One of our foremost oil engineers declares that pessimism about our oil reserves is not justified, that present known crude oil deposits will last 70 years, allowing for oil not readily recoverable by present methods.

This view is definitely not shared by the majority of the students of fuel resources. The fact remains that in many areas, increased exploration in recent years, is resulting in less and less discovery of oil in the ground. If the population must return to the automobile and an increasing amount of air traffic after the war, gasoline is an essential. And production of a given amount of gasoline affects the amount of residual fuel oil and distillate available for boiler fuel and Diesel engine fuel.

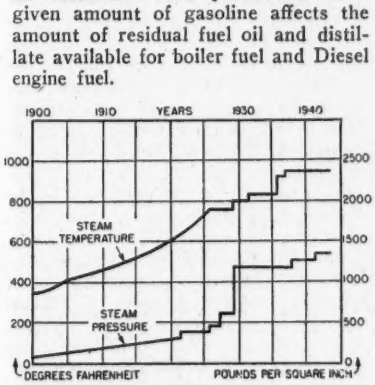

Fig. 10. Progress in throttle steam temperature and pressure of condensing turbines
Source: C. B. Campbell, POWER PLANT ENGINEERING, November, 1944

Importation of oil is clouded by political as well as economic factors. Reserves in the Middle East are not readily available and the haul is great. There is not as much oil in Mexico or South America as we would like to believe.

Use of high-octane gasoline in automobiles may yield mileages up to 40 miles per gallon, thus conserving oil.

Colloidal fuel, a mixture of oil and pulverized coal, has been investigated as an emergency measure to stretch the oil supply, but it has not been proved that this would be economical as a peace-time fuel.

Our Western oil shales have never been exploited commercially and many engineers feel that, if the estimated possible cost of production of gasoline from them, ranging from 3 to 8 cents per gallon, can be substantiated, they stand next to crude petroleum as a logical source of motor fuel.

Table showing summary of program for expansion of Power Production Facilities of Electric Utility Systems by types of units, class of ownership, year of installation. Source: Office of War Utilities. Note—Addition to system capabilities is slightly larger than name-plate rating

	Name-Plate Rating — Kilowatts					
	1942	1943	1944	1945	1946	Total
Privately Owned Plants:						
Fuel	1,226,750	1,738,030	574,745	694,230	293,500	4,527,255
Hydro	69,450	36,600	133,000	.....	.....	239,050
Total	1,296,200	1,774,630	707,745	694,230	293,500	4,766,305
Publicly Owned Plants:						
Fuel	218,020	197,200	7,072	189,921	37,500	649,713
Hydro	861,100	1,051,500	571,400	239,800	.....	2,723,800
Total	1,079,120	1,248,700	578,472	429,721	37,500	3,373,513
Total Privately and Publicly Owned Plants:						
Fuel	1,444,770	1,935,230	581,817	884,151	331,000	5,176,968
Hydro	930,550	1,088,100	704,400	239,800	.....	2,962,850
Total	2,375,320	3,023,330	1,286,217	1,123,951	331,000	8,139,818

Synthetic Fuels

Because we have ample supplies of coal for producing synthetic fuels as well as for all present uses, depletion of our oil reserves makes investigation advisable. The Bureau of Mines has conducted investigations of the production of gasoline from coal by a high-pressure hydrogenation process and is doing preliminary experimental work on the low-pressure Fischer-Tropsch process. Production of synthetic gasoline from natural gas might be another logical outcome.

Natural and Manufactured Gas

Reserves of natural gas, widely used as a fuel in some sections, are increasing in some sections and it is estimated that our present reserves will last 30 years or more. The recycling process, in which gas is returned to the ground after processing, helps extend the reserves. Natural gas is a raw material for gasoline and various chemical products. Such use is growing, also its use as an industrial fuel.

The manufactured gas industry, anticipating a good supply of low-priced oxygen after the war, may be able to increase its production 3 or 4 fold. It hopes to increase the use of gas as a fuel for space heating. By using its equipment in low load periods, it hopes to manufacture synthetic hydro-carbons. It is now sponsoring work in complete oxidation of coal with oxygen and steam under pressure, low temperature carbonization to produce gas for processes and new methods of pulverizing coal to be used in these gas-making processes.

Influence of Fuel on Plant Design

Above all, in the post-war power program, bituminous coal represents the best fuel value that will be available for the power engineer in most cases. As E. C. Payne points out, fuel investigation should precede plant design.

For data on competitive coals available, publications of the U. S. Bureau of Mines, the Department of the Interior and the U. S Geological Survey, various research laboratories at state universities, coal suppliers and others are readily available

Analysis will usually point to one or more producing regions or rate-origin groups capable of supplying best fuel value for a long range plan. There should, however, be a secondary coal available, to be purchased for competitive reasons.

Details of the way in which fuel analysis is applied to an actual case were given in Fairmont Reference Bulletin No. 5. This shows how by comparing four fuels and the design of three steam generating units to burn them, additional cost of unit to burn a wide range of coals would show savings of $78,000 to $100,000 for a 400,000-lb-per-hr steam generating unit; $25,000—$35,000 for a 200,000-lb-per-hr unit, $5000—$7200 for a 60,000-lb-per-hr unit. It was calculated that the additional investment could be amortized in less than one year by the fuel saving under normal market conditions.

Electricity Knows No Bounds

ELECTRICAL ENGINEERS have no misgivings about the future as far as their own work is concerned. They feel confident that the future is going to flow from the past without interruption and with increasing acceleration. Electricity is the common denominator of everything in the Universe and they know that they can make it do anything they want it to do.

Electrical engineers work through the natural laws which govern the workings of the Universe. While these laws are inviolable they are not necessarily limiting. Only man made laws are limiting. As aptly expressed by David Prince of the General Electric Co., nature's laws are partly for the purpose of directing us to the things we can do instead of limiting us to the things that we cannot do.

Some of the things with which electrical engineers and electrical scientists are working with are truly appalling in their ultimate effect on the human race. We know what such things as radar are capable of, we know something of what it means to be able to drop from two to four thousand tons of bombs on the enemy in a single day, and we also know the devastating effect of a pilotless robot plane carrying a ton of explosive when it hits a densely populated center. But we do not know exactly what it would mean if we should find out how to isolate, say 5 pounds of uranium 235. There have been vague reports that the Germans have been working on an atomic energy bomb. No doubt this is true but it does not mean that they have succeeded in producing such a bomb. We, also, have been working on developments of this kind and while it is unlikely that such weapons can be perfected for use in this war, it is not for us to say that they will not be available for a third World War if we are foolish enough to let the politicians lead us into a third war. Such a development would all but finish us. A medium size atomic bomb would wipe out London or New York and in the language of Shakespeare, "leave not a wrack behind". Irving Langmuir, Nobel Prize winner in physics pointed out not very long ago that a quart of electrons separated from associated protons and neutrons would expand with an energy equal to the explosion of a cube of TNT 500 miles on a side, reaching from London to Berlin! National sovereignties become meaningless in the face of such prospects.

These are not pleasant prospects but they are unpleasant only because man can make them so. There is also a pleasant side. Many people throughout the world, now, are worrying about the eventual exhaustion of our oil resources, and this goes for coal also, though coal will last much longer than oil. But if we can learn how to separate electrons from protons there will be no reason for us to be concerned for then we will have a potential supply of energy where one pound of material will give us two billion times as much heat as there is in the best high octane gasoline.

A few years ago, there was considerable discussion in engineering circles about the possibility of direct-current transmission of power. At that time, the problem of overcoming instability on long a-c lines had not been solved to the extent that it is today and direct current at high voltage offered definite advantages. This is still true today and today we are much further along toward the ultimate carrying out of the d-c transmission idea. With our high power electron tubes of the present day it would be quite within the range of possibility to build a high voltage d-c transmission line if we wanted to do so. It is not certain that we want to do so but it could be done. As a matter of fact a short high-voltage d-c transmission line has been in commercial service for a number of years with excellent results.

Today, however, a new possibility exists. We have learned how to transmit power at high frequencies for considerable distances without wires by the use of wave guides. Microwave "plumbing" it is called. So far, this method of transmission has been used only in the communications field but who is to say that the principles involved in this method of transmission will not, some day, be used for heavy power purposes? By this method it is possible to transmit electric power through a rubber hose.

Modern electron tubes have a much more immediate application in the power field than that involved in d-c transmission, i.e. in the conversion of a-c into d-c for control purposes. One of the things electrical engineers have been working on ever since a-c transmission came into general use was an a-c motor that had speed characteristics equivalent to those of the d-c motor. All sorts of ideas were tried, all sorts of makeshifts improvised but no a-c motor, however good, ever was quite as good as the d-c motor in respect to its speed characteristics. Today, however, we can take alternating current of any frequency, convert it to variable frequency for use in a synchronous motor or to direct current for use in an ordinary d-c motor. In other words, today, because of the electron tube, we can operate d-c motors from the a-c lines. As yet, equipment for controlling motors in this fashion is available only in comparatively small sizes but there is nothing in the idea to prevent its use with the largest motors in use—all that is needed are larger tubes.

During the past year there was intalled in one of the large steel mills an electron tube frequency changer with a capacity of 20,000 kw. As described in the December 1944 issue of POWER PLANT ENGINEERING, this unit is designed to exchange power, reversibly, between 25-cycle, 44 kv and 60 cycle, 69 kv systems. Now, 20,000 kw is still comparatively small compared with the power of a 160,000 kw generating unit but it is anything but chicken feed. If we can make a 20,000 kw electron-tube converter, we can make a 100,000 kw unit—it is merely a question of whether we want to do so or not. The day of the rotary converter

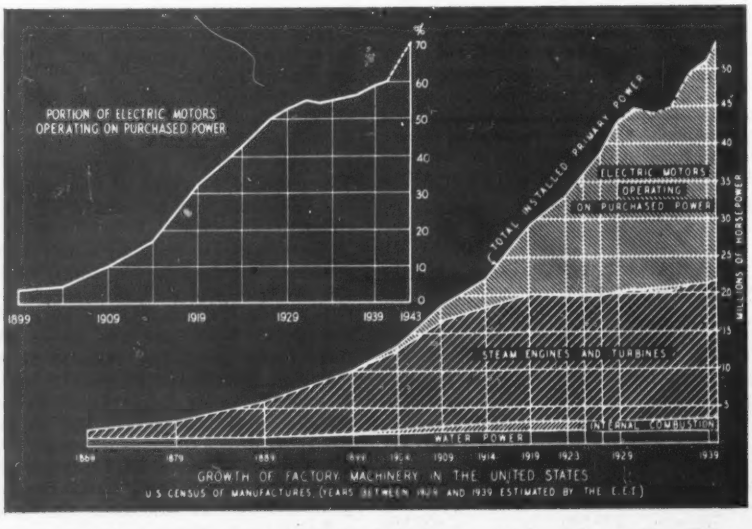

Fig. 11. Steady increase in proportion of industrial power produced by outside utilities. (A) (upper) Percentage of electric motors operating on purchased power. (B) Growth in use of factory machinery in the United States

is about over and nobody will be sorry because they have been sources of plenty of trouble. This does not mean that no more rotary converters will be built; it does mean, however, that increasing attention will be given to electronic conversion.

As has been pointed out in these pages frequently in the past few years there is nothing particularly new about electronics except that, at long last, we are beginning to apply it. Take the case of high frequency heating; this was developed in the laboratory over 20 years ago. In the early twenties it was possible to surface harden small steel parts by means of high frequency currents generated by electron tube oscillators. Only during the last four or five years has this method come into active commercial use. With it, we can take the outside of a metal part, heat it to red heat and chill it again in so short a time that only the surface is hardened. Or, if we want to heat the interior of a body we can do it easily and quickly by similar methods without disturbing the outside of the body. In all these things we have made only beginnings. They will be developed and extended in countless ways.

In the field of measurement and instrumentation, electricity can do anything we require. We can measure distances of a billionth of an inch or speeds within a fraction of a per cent of the speed of light. We can measure electric currents of six electrons per second. By means of the photoelectric recorder, we can record variation in currents measured in microamperes as easily as, a few years ago, we could record currents measured in amperes.

Electricity is also doing things which formerly were done largely by the human brain. In the oil refinery processes, for example, there are processes where hundreds of valves have to be opened and closed in proper sequence. The intervals involved are so short and the multiplicity of the operations so great that it is no longer possible to do them manually so electric brains have been developed which do all these things in perfect sequence and with absolute accuracy.

In some fields, electricity has all but replaced our very thinking processes. Consider a machine developed jointly by Harvard University, the International Business Machine Co. and the Navy during the past few years and now in operation in the solution of complex mathematical problems. This 35-ton mathematical robot can solve any problem in applied mathematics put to it with results reading to 23 decimal places. It actually consults logarithmic and other functional tables. It is powered by a 2-hp motor, works 24 hr a day, 7 days a week and never asks for time-and-a-half. Addition and subtraction takes the machine 0.3 second; multiplication, 5.8 seconds; division, 14.7 seconds. In a period of 19 hr, it solved a problem which had required 3 weeks' work by 4 experts using ordinary office calculating machines. In some ways, this algebraic superbrain is one of the most remarkable inventions to come out of the war.

Fig. 12. Electricity at night

In some fields of electrical engineering, it might seem that we have gone about as far as we can go. We have generators and transformers so high in efficiency that unless we do away with the law of conservation of energy we cannot expect to have much further development. Transformers have been built with efficiencies better than 99.5 per cent. What more can we ask for in this direction? Not much, true, but as David Prince has pointed out, we can still make transformers and generators smaller and we can develop new materials to make them better in other ways than merely increase their efficiencies. We are learning how to make them faster and cheaper and so, more available to mankind. For the first time in history we have 30,000 hp steam turbines in quantity production; at the same time we have reduced the number of man-hours to make one of these units to 71 per cent of what it used to take before the machines were standardized.

As far as future progress is concerned, from a technical standpoint there is practically no limit to what we will be able to do if we want to do it. The war has brought this home to us as never before. Many technical developments are held back merely by the fact that a small group of people cannot make any money out of them. That happens to be the case with television. We could have excellent television today, indeed we have it, but its commercial development is held back by a sort of vicious circle involving on the one hand, the buyer of television receivers and on the other hand, the buyer of television service. Unless there are enough television receivers installed in the homes throughout a certain area, the television broadcast stations cannot get sponsors to pay for television programs. Converesly, unless the public is assured of satisfactory television programs, people are not inclined to purchase television receivers at a price of from $200 upwards.

What is true of television in this respect is even more true in many other branches of the electrical art. So far we have barely scratched the surface in the use of electricity but we need something in peacetime, comparable to what we have in war to make us develop these uses.

POWER For Dunn Sulphite Paper Co.

Moderate size, highly efficient power plant for Port Huron paper mill incorporates features usually found only in large central stations. It is built on the unit principle with a single 40,000 lb per hr, 650 psi boiler and one 2000-kw extraction-condensing turbine. The operating stations are all on one level and there is no dividing wall between the boiler and turbine rooms. Pulverized coal is used as fuel with provision for the use of oil for starting and for emergency in case coal is unavailable

SEVERAL years ago, the Dunn Sulphite Paper Co., located on the St. Clair River at Port Huron, Michigan, was confronted with the problem of replacing or rebuilding its old and outmoded steam plant. This old plant consisted of three boilers supplying steam at 165 psi, part going direct to process use through reducing valves and part to a Corliss engine driving a direct current generator. The exhaust from this engine also was used in process work involving the manufacture of special paper to which this plant is devoted. Power for operating the alternating current motors was purchased from the local utility company.

It was obvious, considering the age of the boilers and the growing load that the old boiler plant would become increasingly inadequate, so after a careful study of the power requirements by the engineering firm of Burns and Roe, Inc., of New York, it was decided that the best solution to the problem lay in a completely new power plant, producing both steam and electricity. Studies showed that best economy would be obtained by the use of a single boiler supplying steam at 625 psi at a temperature of 725 F, to an extraction-condensing turbine. This recommendation was accepted and the new power plant was finished just before the war put a stop to this type of construction.

The plant is interesting because its design incorporates features not ordinarily found in moderate size industrial plants—features which, however, have proved their worth in large central stations. For example, to keep the operation as simple as possible, the plant was designed on the unit principle. The first unit, now in operation, comprises a single 40,000 lb per hr steam generator supplying a 2500 kva turbine generator. The entire operating floor is on one level with no dividing wall between the boiler and turbine rooms. This simple, compact layout reduced the first cost and makes the operation as simple as possible, the boiler control and operating end of the turbine facing each other.

The general arrangement of the plant and equipment is shown in the accompanying plan and elevation. The boiler is fired by pulverized coal but oil burning equipment is also provided. The coal comes to the plant in self-unloading steamers, discharging the coal into a storage yard at one end of the plant. Coal is moved from the storage pile to the hopper of a bucket elevator just outside the building by a drag line. The bucket elevator, being installed in an inclined position, lifts the coal to a 75

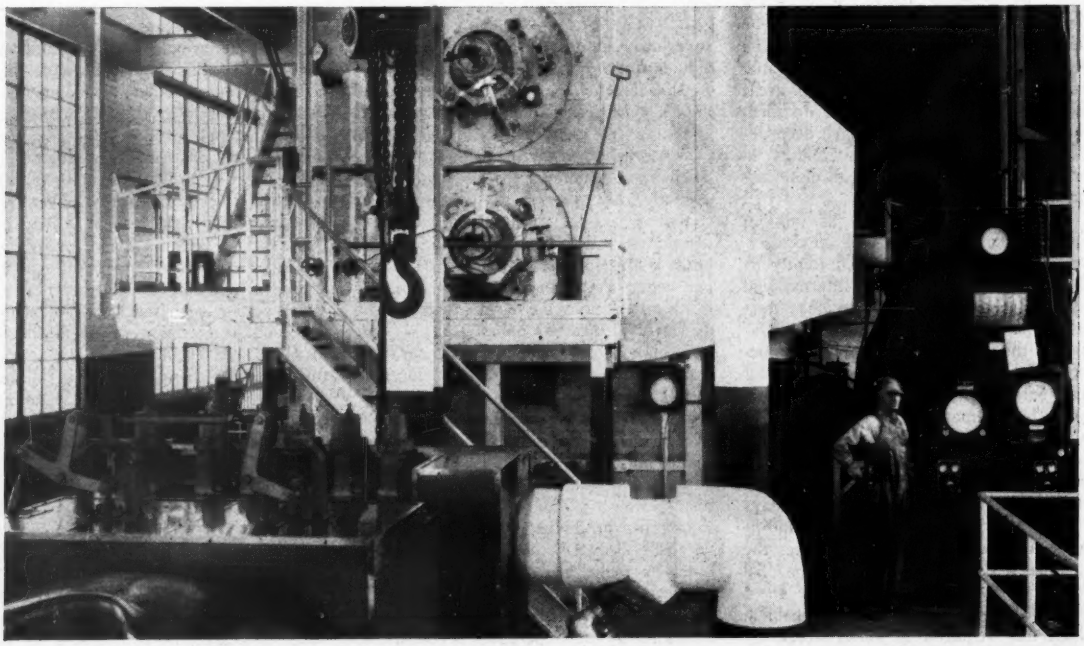

Fig. 1. General view, looking from the turbine room into the boiler room, showing the 2000-kw turbogenerator in the foreground with the boiler in back. Boiler control panel is shown at the right

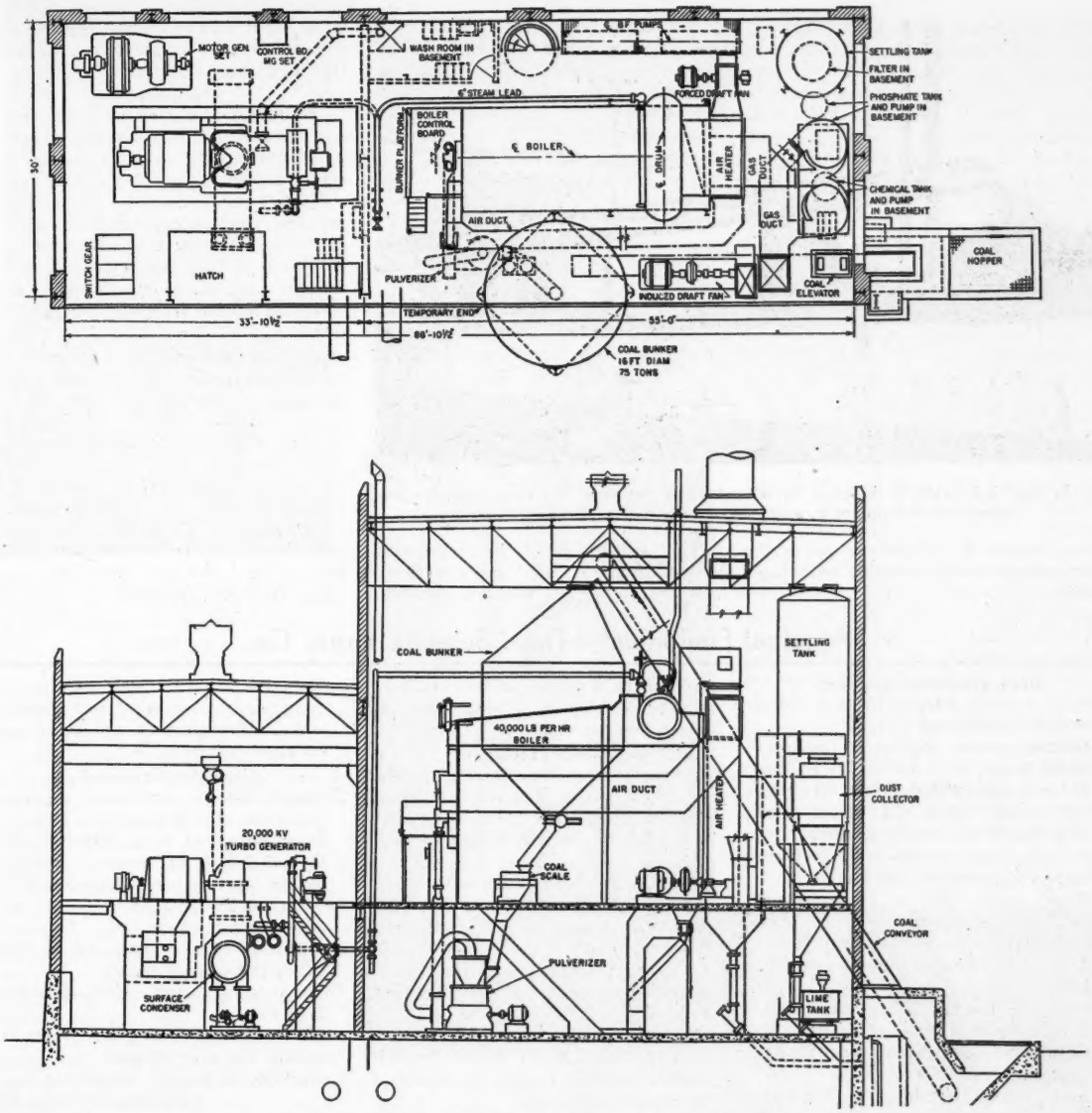

Fig. 2. Plan and elevation of the Dunn Sulphite power plant showing the arrangement of equipment

ton steel bunker. From the bunker it is discharged into an apron feed coal scale and then to a single bowl mill which supplies two 7-in. combination coal and oil burners in the front wall of the furnace.

Provision for Future Expansion

It will be noted from the plan view, Fig. 2, that the coal bunker is built half within and half outside the building. This was done with the future, second unit in mind. The coal bunker which is 16 ft in diameter is large enough to serve two boilers and when the second unit is built, the bunker will be in the center of the building, between the two boilers. The wall in which the coal bunker is located is a temporary wall and will be removed when the second unit is constructed.

The coal scale which is of the automatic type is located on the operating floor and feeds directly into the pulverizer on the floor below. The latter is a Raymond bowl mill, with a capacity of 4910 lb per hr and built with an integral exhauster.

Pulverized coal is the normal fuel. Oil is used only for starting and for emergency use. The oil handling equipment consists of a 12,000 gal underground storage tank, heaters and pumps which will, if required, handle the full load of the boiler.

The steam generator consists of a 40,000 lb per hr, 2-drum fully water cooled integral furnace boiler, with 3850 sq ft of heating surface in the boiler proper, and with a four hour maximum capacity of 48,000 lb per hr. The unit is built for an operating pressure of 650 lb 725 F maximum temperature. The upper rear drum is fitted with bubble type steam washers.

The furnace water walls have 1622 sq ft of surface in the front, sides and bottom screen. The superheater is a ball-joint interbank unit. A tubular type air heater with 3775 sq ft of surface is located at the rear of the boiler.

Forced- and induced-draft fans are located on the operating floor on opposite sides of the boiler as shown in Fig. 2. A single constant speed motor drives the forced-draft fan. The induced-draft fan is driven by a constant speed motor through an hydraulic coupling for speed control. The forced-draft fan is of the vane control type and has a capacity of 14,400 cfm at 9.63 in. H_2O static pressure. The induced-draft fan has a capacity of 25,900 cfm at 7.84 H_2O in. static pressure.

Combustion control is provided by a full automatic air-actuated combustion control system coordinating the draft and fuel feed. This control is centered in the boiler control panel to the right of the boiler. This panel, in addition to the combustion control adjustment de-

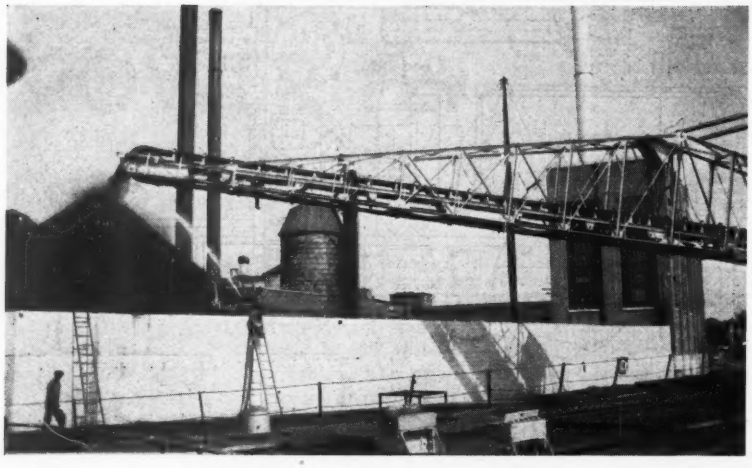

Fig. 3. Coal is brought to the plant by self-unloading steamers. This view shows the coal being placed in storage by a large movable belt conveyor on a steamer

vices, contains a multiple register draft gage, a boiler meter and other recording meters.

The arrangement of the combination oil and pulverized coal burners is shown in Fig. 1. They are mounted vertically in the front wall of the furnace and are rendered easily accessible by a small structural steel platform.

Feedwater

Feedwater is treated by a hot process, lime and soda softener with a capacity of 2400 gal per hr. This system includes a 5000 gal per hr settling tank, a 50,000 lb per hr deaerator and an automatic adjustable spray heater for make-up. Filter unit, chemical tank with motor-driven agitator, motor-driven chemical pump, phosphate tank and pump and backwash pump, complete the installation.

All condensate returns from the paper mill as well as all drips and drains go to a settling and deaerating section of the softener. Filtered water from the general plant supply goes to an automatic adjustable spray heater section of the softener where steam from a low pressure header raises the temperature of the make-up to 260 F. The heated and deaerated water is then pumped direct to the boiler, and controlled by a Copes feedwater regulator.

Principal Equipment—Dunn Sulphite Paper Co.

Steam-generating Equipment

BOILER, 2-drum, integral-furnace..Combustion Engineering Co., Inc.
Heating surface: 3850 sq ft. Capacity: 40,000 lb per hr at 625 lb, 725 F, max 24-hr rating; 48,000 lb per hr, max 4-hr rating. Upper rear drum fitted with bubble-type steam washers.

FURNACE, hopper-bottom.....Combustion Engineering Co., Inc.
Water walls: 1622 sq ft, front and sides, bottom screen.

SUPERHEATER, Elesco ball-joint, interbank....Combustion Engineering Co., Inc.

AIR-HEATER, tubular, 3775 sq. ft. ..... Combustion Engineering Co., Inc.

SOOT BLOWERS.....Vulcan Soot Blower Company

WATER COLUMN, bi-color.....Diamond Power Specialty Corp.

SAFETY VALVES.....Consolidated-Ashcroft-Hancock Div.

Combustion Equipment

PULVERIZER, Raymond bowl mill, motor driven .....Combustion Engineering Co., Inc.
With integral exhauster. Capacity: 4910 lb per hr nominal.

BURNERS, 2, combination coal and oil.... .....Combustion Engineering Co., Inc.
Burners and mill give a load range of 6:1, or 48,000 to 8000 lb per hr evap.

COMBUSTION CONTROL, full automatic, air-actuated ...Bailey Meter Company

Fuel-handling Equipment

WEIGHT SCALES, apron-feed, 100-lb hopper.....Richardson Scale Co.

COAL BUNKER, 75-ton, cylindrical..... Beaumont-Birch Co.

OIL STORAGE TANK, 12,000 gal..... Pittsburgh Des Moines Steel Co.

BUCKET ELEVATOR, inclined continuous... Beaumont-Birch Co.
2 strand, 9-in. pitch, stock roller chain, overlapping 9 x 16-in. buckets, on 18-in. centers. Driven by 7.5-hp, 440-v, 3-phase, 60-cycle motor.

Ash-handling Equipment

FLUSHING SYSTEM..Beaumont-Birch Co.
Ash flushed from double-boiler hopper and single hoppers of air preheater and dust collector, by means of dust quenchers and necessary 8-in. CI piping, fittings, and machined rotary valves. Flyash from boiler last pass flows by gravity to the boiler ash hopper.

Draft Equipment

FORCED-DRAFT FAN.....American Blower Corp.
Capacity: 14,400 cfm at 9.63 in. H_2O static pressure. Motor driven, through flexible coupling. Control accomplished by means inlet vanes.

INDUCED-DRAFT FAN....American Blower Corp.
Capacity: 25,900 cfm at 7.84 in. H_2O static pressure. Motor driven, through hydraulic coupling.

DUST COLLECTOR.....Buell Engineering Corp.
Two Van Tongeren-system cyclones, 2 volute gas dischargers, and common hopper.

Boiler-feed System

BOILER-FEED PUMPS, 2, 2½ in. 6 stage diffuser type.....Dean-Hill Pump Co.
One driven by Elliott, 125-hp, 3550-rpm steam turbine (600 lb, 725 F at throttle). One driven by 100-hp, 440-v, 3-phase, 60-cycle, 3450-rpm s-c motor.

FEEDWATER REGULATORS, Copes..... Northern Equipment Co.

Feedwater Treatment

HOT-LIME-SODA SOFTENER, 2400 gal per hr.....The Permutit Co.
Includes 5000-gal per hr settling tank, 50,000 lb per hr deaerator, automatic adjustable spray heater for makeup, filter unit, chemical tank with motor-driven agitator, motor-driven chemical pump, phosphate tank and pump, and backwash pump.

Generating Equipment

TURBINE, 2000-kw, condensing, automatic extraction....Allis-Chalmers Mfg. Co.
Impulse-reaction type, 3600-rpm, 600 lb and 725 F at throttle, automatic control of extraction at from 5 to 50 lb.

GENERATOR, 2500-kva, air-cooled..... Allis-Chalmers Mfg. Co.
4800-v, 60-cycle, 3-phase, 0.8 pf, with 125-v, 15-kw shaft exciter.

GENERATOR AIR COOLER....Allis-Chalmers Mfg. Co.
Air circulated: 7650 cfm. Water required: not over 90 gpm.

CONDENSER, horizontal, single-pass..... .....Allis-Chalmers Mfg. Co.
Divided water box, welded-steel shell, 2080 sq ft, surface.

CIRCULATING PUMP, centrifugal..... Allis-Chalmers Mfg. Co.
Driven by 100-hp 440-v, 3-phase, 60-cycle squirrel-cage motor.

CONDENSATE PUMPS, 2, centrifugal..... Allis-Chalmers Mfg. Co.
One driven by 7.5-hp. Allis-Chalmers impulse turbine, 1750 rpm, 600 lb, 5-50 lb backpressure. One driven by 7.5-hp, 440-v, 3-phase, 60-cycle, s-c motor.

EVACTOR (air pump).....Croll-Reynolds Engineering Co.

ATMOSPHERIC RELIEF VALVE.....Atwood & Morrill Co.

Miscellaneous Pumps

DRIP AND DRAIN PUMP, centrifugal..... Allis-Chalmers Mfg. Co.

CONDENSATE-RETURN VACUUM PUMP..... Nash Engineering Co.

Electrical Equipment

MOTOR-GENERATOR SET, synchronous, 300-kw.....General Electric Co.
450-hp, 4800-v synchronous motor (3-

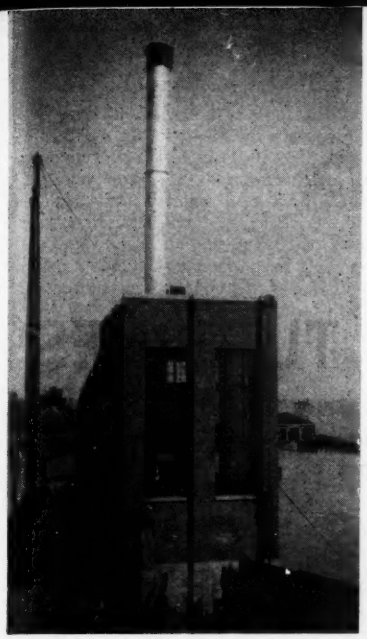

Fig. 4. Exterior view of the power plant. The wall at the left is the temporary wall which may be removed when the second unit is added

phase, 60-cycle) driving 1200-rpm, 250-v compound-wound d-c generator.

MAIN SWITCHBOARD, metal-clad..... Westinghouse Electric & Mfg. Co. Hinged panels with semi-flush instruments. Oil circuit breakers 600-amp, 15-kv, manual closing, electrical tripping. Five panels: main feeder to paper mill (4800 v), service transformers, motor-generator set, turbine-generator main control, turbine-generator field and voltage regulator.

OUTDOOR SUBSTATION, service transformers.....Allis-Chalmers Mfg. Co. 3, 150-kva, 4800/480-v, single-phase, 60-cycle transformers.

Piping Valves

CIRCULATING WATER PIPING, electric welded...Taylor Forge & Pipe Works; Murray W. Sales & Co.

STEAM AND WATER PIPING....Pittsburgh Piping & Equipment Co.

INSULATION OF PIPING AND SOFTENER TANK.....Johns-Manville Co.

VALVES.....Chapman Valve Mfg. Co., Edward Valve Mfg. Co.

REDUCING AND DESUPERHEATING STATION .....Swartwout Co.

Construction

STACK, breeching, flues.....Connery Construction Co.

INSULATION, Eagle-Picher and Unibestos .....G. H. Gotshall Co.

STRUCTURAL STEEL.....Flint Structural Steel Co.

ROOF DECK.....Federal American Cement Tile Co. 3½-in., precast concrete channel slabs on boiler house, 2¾-in. precast concrete channel slabs on turbine roof.

ROOF DRAINS.....The Barrett Co.

ROOFING .....The Barrett Co.

VENTILATORS, 2—36-in. protected-metal fans with dampers....H. H. Robertson Co.

SASH AND DOORS.....Truscon Steel Co.

Two boiler feed pumps are provided. These pumps and the condenser condensate pumps are among the very few pieces of equipment in this plant installed in duplicate. Both pumps are 2½ in., 6-stage, diffuser type pumps, one driven by a 125 hp 600 psi steam turbine, the other by a 100 hp squirrel cage motor.

Concentration of the water in the boiler is controlled by a continuous blow down system. The feedwater is sampled at regular intervals, analyzed, and treated accordingly.

Turbine Equipment

The turbogenerator, as previously stated, is a 2000-kw, condensing, automatic extraction unit of the impulse-reaction type, operating at 3600 rpm with steam at the throttle, 600 psi, 725 F. The unit is designed for automatic extraction at pressures from 5 to 50 psi.

Individual, spring loaded poppet valves operated by cams control steam admission to the first stage of the turbine, while a double seated balance piston valve regulates the steam flow to the low pressure blading beyond the extraction point. Both sets of valves connect through linkages and oil relay cylinders to the speed governor and the extraction pressure regulator, so that both respond to changes in the electrical load or the process steam load. Turning a hand wheel at the pressure regulator changes the extraction pressure setting.

A 2080 sq ft horizontal single pass surface condenser with divided water box handles the steam sent through the low pressure blading when the electrical load is high in relation to the process steam load. The condenser is located on the floor below the operating floor.

River water pumped through the condenser goes to filters for mill use, thus saving the heat picked up as it passes through the condenser. Duplicate condensate pumps, one electrically-driven and the other motor-driven, insure reliability.

The turbine drives a 2000-kw, 0.8 pf, 3600 rpm, 60 cycle, 3 phase generator operating at 4800 v which permits a tie-in with the public utility company. Normally all the alternating current power needed by the mill is produced by the turbogenerator.

(*Continued on Page* 93)

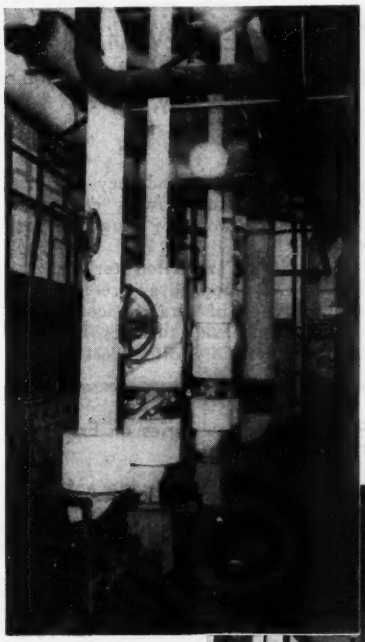

Fig. 5. A photograph showing the two boiler feed pumps

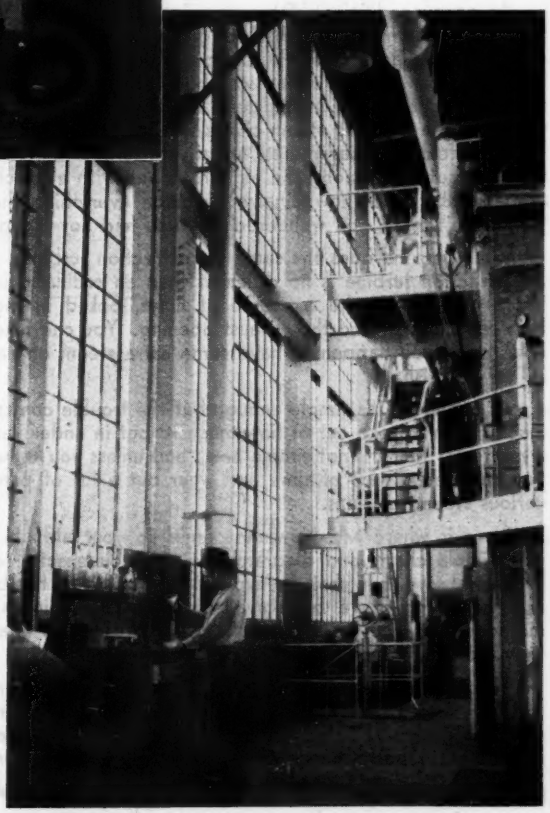

Fig. 6. Looking north in the boiler room showing the water analyzing equipment

MODERN EXTRACTION TURBINES*

Part I. Factors Influencing the Design of Automatic Extraction Steam Turbines

By L. E. NEWMAN

Turbine Division, General Electric Company
Schenectady, N. Y.

AUTOMATIC extraction steam turbines are the multi-purpose tools of the power plant designer. They meet exacting needs for both power and steam without special attention from their operators; they maintain steam pressure constant in one or more process lines; they can hold electrical frequency close enough for operation of electric clocks. And they do these many-purpose tasks with efficiencies approaching those of single-purpose turbines.

Automatic extraction turbines are not so easily applied as are the more simple types of straight condensing and non-condensing turbines. But their inherent flexibility often deceives the careful observer into believing that their application is good when it is not.

For example, an automatic extraction turbine might be designed to extract 100,000 lb of steam an hour, yet never be called upon to extract more than perhaps 10,000 lb an hour. The result would be that a portion of the turbine operated at one-tenth its design flow with consequent loss in economy. This loss is not easily recognized. The turbine meets its guarantees, and carries its full rating. It fails in no way to meet expectations, even to making a handsome saving in the fuel bill. Only its designer could tell "what might have been" had the turbine been designed for the actual maximum required extraction flow instead of an inflated value.

In nearly every case the engineer applying automatic extraction turbines will find it wise to call for a liberally designed turbine. The machine is thus better equipped to meet future demands unknown at the time of its purchase. But this flexibility is costly in fuel if overdone. More so than is true with other turbines, the designer of the automatic extraction turbine should be given carefully estimated conditions under which it is expected to operate. It is the application engineer, however, who must weigh the factors influencing the design of each turbine, and it is the purpose of this article to acquaint him with some of these factors.

The basic types of automatic extraction turbines are shown schematically in Fig. 1. These four basic types are misleadingly few. They do not indicate industry's need for main pressures varying from 150 psi to more than 1000 psi; for initial temperatures varying from 500 F to over 900 F; for extraction pressures ranging from atmospheric to 400 psi; for exhaust pressures of one inch mercury absolute to over 200 psi. These four sketches in Fig. 1

HERE IT IS—the first article in L. E. Newman's new series on Extraction Turbines, a bang-up job from start to finish.

As announced in our December issue, this new series by the author of "Modern Turbines" published originally in Power Plant Engineering and now available as a book, takes up where the first series left off. Perhaps you remember the first series, way back in 1937; how Lou Newman unfolded for you in gentle fashion the deep mysteries of turbine design. How he led you past awe inspiring steam charts without batting an eye, how he attacked the most fearsome parameters underlying turbine design with utter disregard for his reputation among the highbrows and with a nonchalance born only of a specialist's mind; how, finally, he made everything that goes on inside a turbine so simple, you wondered why you had not thought it out yourself.

Well, here he does the same for extraction turbines. Actually, of course, an extraction turbine is no different than an ordinary turbine except that it has a hole, or maybe a couple of holes, poked in the casing somewhere between the inlet and the exhaust opening. You can take steam out of these holes or, if you happen to have some extra steam on hand, you can feed it in, as you wish.

As a gadget it's simple enough but the trouble comes in figuring out how much steam to take out or how much to put in under varying conditions. As a matter of fact it's not simple at all and unless you know how to go about it you can waste a lot of time and wear out a lot of pencils figuring out the various steam relations.

Here is where Mr. Newman comes to your aid. In clear language and with simple charts and diagrams, he tells you exactly how to go about the process. More than that, he explains how to do all this by short cut methods that heretofore have been available only to turbine specialists. They are methods that save you time; they are accurate, and what is more important, they are easy to understand.

This first article is introductory; it helps you get your feet on the ground so that you can better understand what is to follow. From here on, Mr. Newman has promised to pull no punches. You will get methods that will help you estimate performance in half the time your present "short-cuts" take.

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do not call attention to the fact that the steam might go in or out (extraction or mixed pressure) of each opening, nor does the sketch mention the 14 standard ratings now built from 500-kw to 7500-kw.

This range, 500-kw to 7500-kw, represents the major portion of the field for automatic extraction turbines. They have been built for less than 500-kw rating and for much greater than 7500-kw, but it is uncommon to find them outside this range.

Figure 2 illustrates in cross-section typical turbines of the automatic extraction type. These turbines are characterized by internal automatic devices that maintain substantially constant steam pressure at one or more openings in the turbine casing. These internal devices are commonly annular grid valves, or poppet valves. For high efficiency over a wide range of steam flows, these internal valves are sectionalized. In most cases the valves are controlled by a steam-pressure governor connected at the extraction opening. With a rise in steam pressure to the extraction line, the pressure governor opens the extraction control valve an amount sufficient to return the pressure to normal.

Note in these few cross-sections of Fig. 2 the variations in design. The 750-kw turbine and the 5000-kw turbine have single-stage high-pressure sections. The others have four or five stages in this section. The 1500-kw, 3000-kw, and 7500-kw turbines have first stage wheels with only a single row of buckets; the others have first stage wheels with two rows of buckets. These great variations in design are not whims of the designer. They are deliberate variations to improve efficiency in one part of the operating range of the turbine at the expense of a less important part of the range. The designer can usually choose the elements of the turbine such as to favor extraction operation, if this is the re-

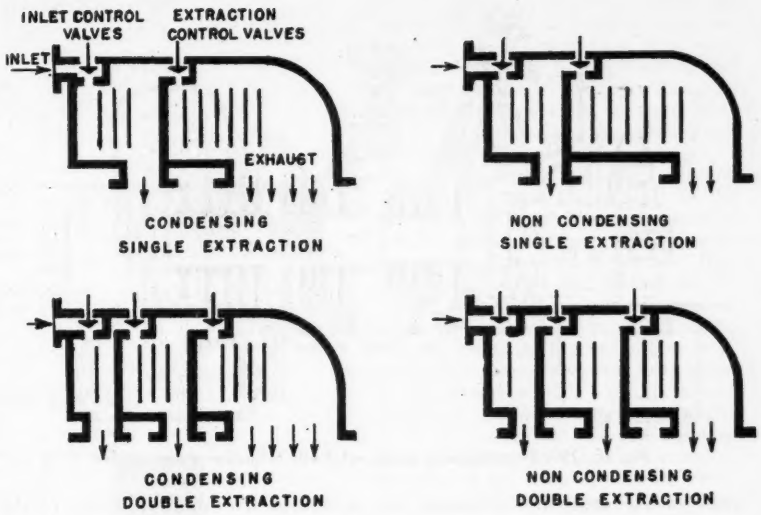
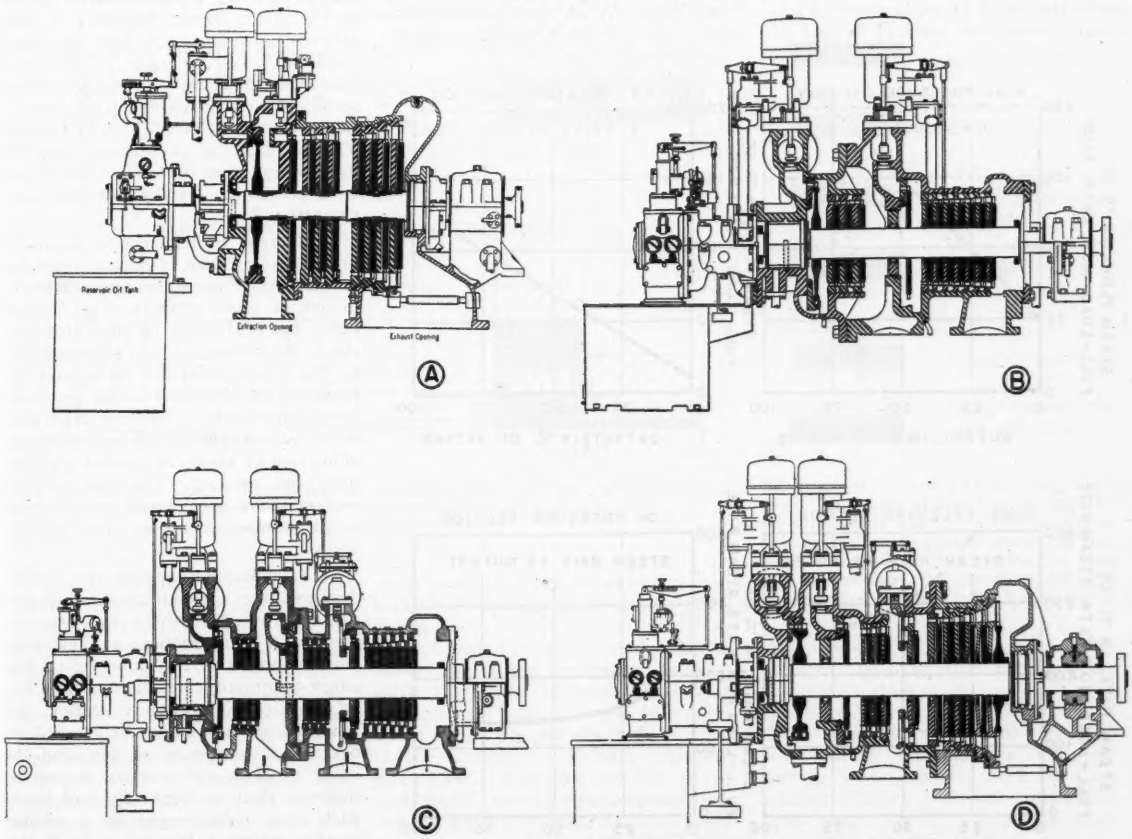


Fig. 1. Types of automatic extraction steam turbines



A. 750-kw condensing single extraction steam turbine
B. 1500-kw non-condensing single extraction steam turbine
C. 3000-kw non-condensing double extraction steam turbine
D. 5000-kw condensing double automatic extraction steam turbine

Fig. 2 A to E. Cross sections of typical automatic extraction steam turbines

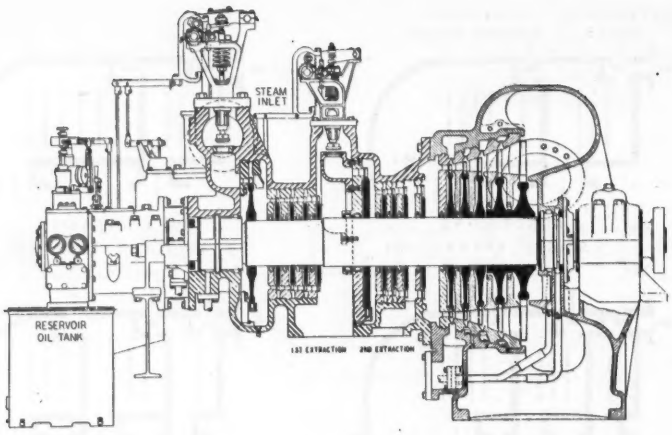


Fig. 2E. 7500-kw condensing single automatic extraction steam turbine

quest of the application engineer, or the designer can favor non-extraction operation, if that appears to give the best overall result. In some machines this latitude of design can make a difference in output for the same steam flow in the order of 15 per cent. For efficiency, with flexibility to meet a broad range of conditions, the application engineer needs to know much about the expected conditions of operation.

The most important conception to get in the study of applications of automatic extraction turbines is that of a Willans line for *each* section of the turbine. Fig. 3 shows typical Willans lines for the high-pressure and low-pressure sections of a single automatic extraction turbine. Directly beneath these Willans lines (i.e. steam-flow vs. output charts) the corresponding steam rate curves are plotted. It is evident from these steam rate curves that the most efficient point for the high-pressure section is at its maximum flow, and the most efficient point for the low-pressure section is also at its maximum flow. What these section-flow charts fail to show is that these points of best efficiency for the two sections of the turbine do not occur at the same time. The Willans lines show that when full load with no extraction is being carried, 75 per cent of the load for this particular turbine would be carried by its low-pressure section, and only 25 per cent of its load by its high-pressure section. Under this condition, the low-pressure section would be operating at its maximum flow and maximum efficiency, but the high-pressure section would be operating at just half its maximum flow with correspondingly poorer efficiency.

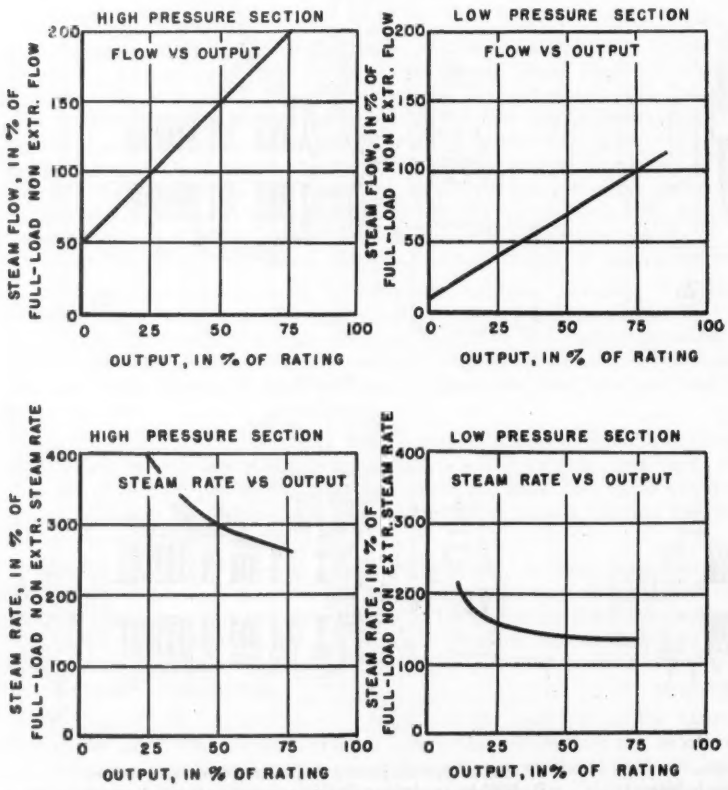

HIGH PRESSURE SECTION
FLOW VS OUTPUT
STEAM FLOW, IN % OF FULL-LOAD NON EXTR. FLOW
OUTPUT, IN % OF RATING
LOW PRESSURE SECTION
FLOW VS OUTPUT
STEAM FLOW, IN % OF FULL-LOAD NON EXTR. FLOW
OUTPUT, IN % OF RATING
HIGH PRESSURE SECTION
STEAM RATE VS OUTPUT
STEAM RATE, IN % OF FULL-LOAD NON EXTR. STEAM RATE
OUTPUT, IN % OF RATING
LOW PRESSURE SECTION
STEAM RATE VS OUTPUT
STEAM RATE, IN % OF FULL-LOAD NON EXTR. STEAM RATE
OUTPUT, IN % OF RATING

Fig. 3. Flow vs Output and Steam Rate vs Output Curves for high-pressure and low-pressure sections of a typical single automatic extraction steam turbine

In order for the high-pressure section to operate at its most efficient point the flow through the high-pressure section is increased, and the flow through the low-pressure section reduced. The excess in flow from the high-pressure section is extracted. Thus, for the condition of full load with maximum extraction, 75 per cent of the load is carried by the high-pressure section, and 25 per cent by the low-pressure section. The high-pressure section under this condition is operating efficiently, but now the low-pressure section is operating far from its most efficient flow.

These conditions are shown in Fig. 4 along with two similar conditions at 50 per cent of rated output. The same section-flow vs. output charts shown in Fig. 3 are repeated in Fig. 4 with arrows indicating the flow for each condition. To the right of the flow curves a schematic illustration of the turbine shows by shaded areas the actual steam flow through each section. The numbers in parentheses are the flows to and from the turbine, expressed as a percentage of the full-load non-extraction flow.

This type of diagram is useful in understanding how different types of extraction turbines are made oversize in one or more sections. Fig. 5 compares different types of such turbines. All of the turbines shown schematically in Fig. 5 are rated the same, and are designed for the same initial and final steam conditions. The only difference is in the arrangement for extraction or admission of steam at a point between inlet and exhaust. The sizes of the sections have been drawn proportional to an assumed maximum flow for each section.

It is apparent that only the turbine designed for non-extraction operation can operate with both its high-pressure and low-pressure sections at their most efficient points at the same time. The single-automatic extraction turbine has an oversize high-pressure section, the low-pressure admission turbine has an oversize low-pressure section, and the other turbines are oversize in one or more of their sections. By and large, each such enlargement of a turbine section means a loss of at least two per cent in the economy of the turbine when operated non-extraction at full load. The loss at partial loads is greater.

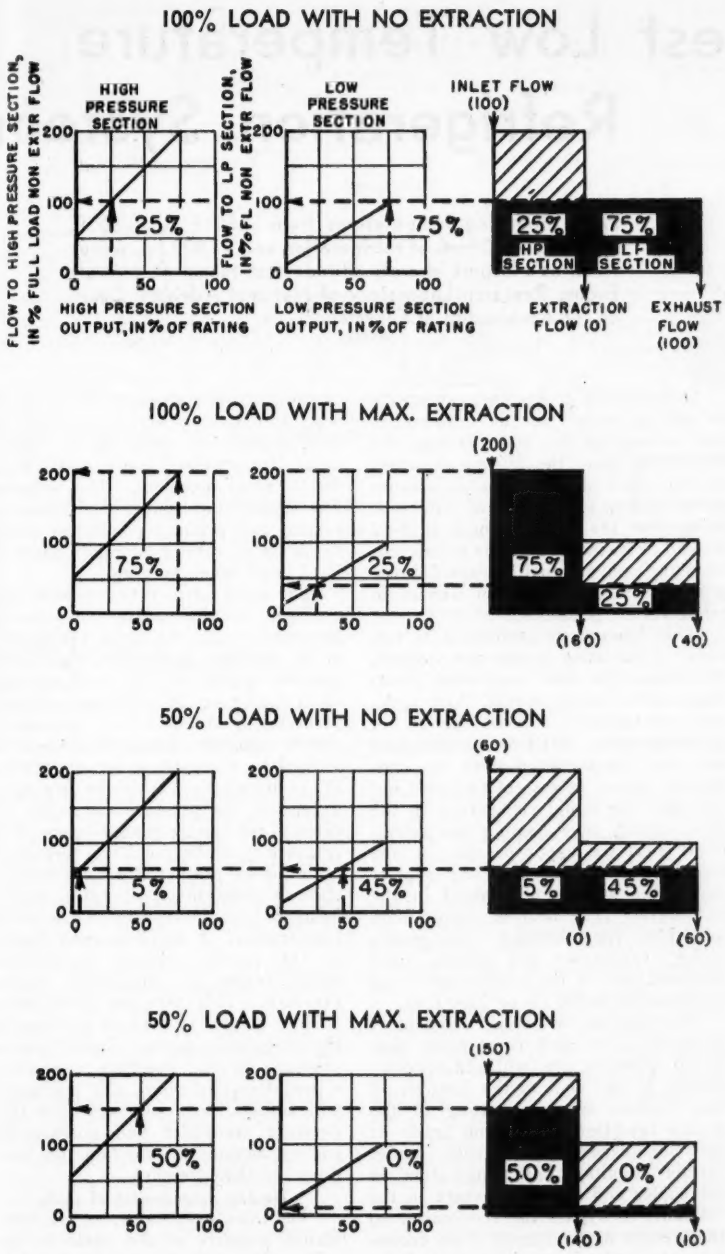


Fig. 4. Section Flow Output Curves showing division of load between high-pressure and low-pressure sections of the same single automatic extraction turbine operating under different conditions

It may be expected, therefore, that extraction turbines will be less efficient than non-extraction turbines. This is true, but care must be used not to misinterpret what it means. It is true, for example, that a single-automatic extraction turbine will be poorer in economy at all comparable non-extraction points than a similar turbine having no provision for extraction. But the extraction turbine operates on so much more efficient a cycle than the non-extraction turbine that it turns out to be *thermally* more efficient in most cases. If it does not prove thermally more efficient than a non-extraction turbine, its application should be questioned.

The second important conception to understand in the application of automatic extraction turbines is that flow through any section of the turbine is increased in almost direct proportion to the increase in absolute pressure just ahead of that section. This is encountered in most single-automatic extraction turbines. Most such turbines are designed to carry normal load with no extraction, but can carry an increased load by permitting the pressure at the extraction opening to rise. Inasmuch as this is a condition occurring at little or no extraction, it is wise to take advantage of the pressure rise to carry maximum load. By doing so it is possible to provide necessary flexibility without making the exhaust section needlessly oversize.

This conception of increased flow through a section proportional to the increased pressure before the section has a second important application to the design of extraction turbines. It is encountered when the turbine is designed to extract steam at a pressure adjustable over a large range. It might be, for example, that a turbine was required to extract steam at one season of the year at perhaps 5 psi, gage, and at another season this pressure might be 15 psi, gage. In terms of absolute pressures, these are respectively 20 psi, abs and 30 psi, abs; an increase of 50 per cent. This can mean, perhaps, that the exhaust section could be 50 per cent larger than a casual inspection of the requirements would indicate. Undersize sections limit the ability of the turbine to meet all requirements; oversize sections are costly in fuel.

The automatic extraction turbine offers the power plant designer flexibility. It offers good efficiency, particularly where the extraction flows are large. But vigilance in application is necessary at all times. The engineer

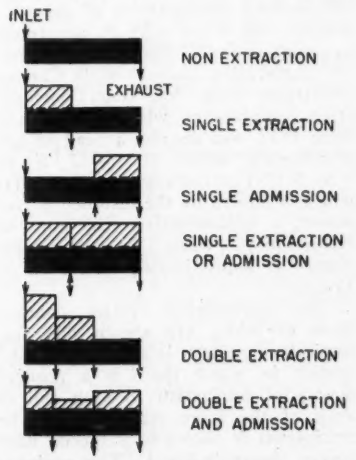


Fig. 5. Comparison of different types of turbines. All are the same rating designed for the same initial and final steam conditions. Sizes of sections are proportional to the maximum flow through that section. In each case the shaded area represents the flow required for full load with no extraction

should question whether the design flows are so large that they penalize normal operation; or too small to meet future demands. The engineer should check to see whether small extraction flows cannot be handled better by reducing valves, and check to see whether large sustained extraction flows might justify a separate noncondensing turbine.

It is a field wherein facts before application pay great dividends.

World's Largest Low Temperature Refrigeration System

By M. J. Wilson

Engineer, Carrier Corp., Syracuse, N. Y.

Plant producing temperatures from +59 F to —80 F, requiring 7500 tons of refrigeration and 21,000 hp, serves America's largest aircraft altitude test tunnel at Aircraft Engine Research Laboratory of National Advisory Council for Aeronautics at Cleveland*

THIS tunnel is used for testing performance and checking operation of new types of aircraft propulsion units at condition of temperature and density comparable to those existing at any altitude up to 50,000 ft. Velocity in excess of 500 mph may be attained in the test section.

The main purpose of the refrigerating system is to extract the heat generated in the tunnel by the fan which circulates the air and by the engine on test and at the same time maintain a temperature corresponding to the altitude at which the test is being conducted. Temperatures for standard tests may vary between +59 F and —67 F.

The 21,000 hp refrigerating system will produce temperatures of approximately —80 F to +59 F, according to requirements of the particular test. The installation consists of 14 Carrier centrifugal type, four-stage refrigerating compressors, which, when handling F-12, will develop a head of approximately 20,000 ft. (—67 F to +86 F.) The instantaneous capacity, which is limited by the installed horsepower, is approximately 7500 tons of refrigeration, while the refrigerant charge is approximately 58,000 lb of Freon.

The refrigeration system, connections of which are shown diagrammatically in Fig 1, is a "flooded-flash" system in which there is a positive supply of refrigerant to each coil of each of the large evaporators. The refrigerant is cooled in a special flash cooler, shown in Fig 1. This cooler is 55 ft in length and approximately 6 ft in diameter, and the sub-cooled refrigerant is circulated by liquid pumps to the various evaporators serving each tunnel or test unit. Under maximum load conditions, approximately 2200 gpm of Freon is handled by the two main pumps. This refrigerant is distributed to 260 coils of the plate fin type, which comprise the evaporator of the largest tunnel, by specially designed distributing valves which compensate for the static head even with variable flow and by orifices which compensate for pipe friction in the header.

Occasionally it becomes necessary to defrost certain of the evaporators after a lengthy test run. During the defrosting cycle the system operates on the same principle as a vacuum steam heating plant; the only difference being that the volatile liquid is F-12 instead of steam. The cycle is different from the conventional hot-gas defrosting and is an application unique in refrigeration practices.

This function is performed as follows: Circulating pumps are stopped, whereupon the float controlled throttling valves in the special float tanks open to maintain a fixed suction on the evaporator. Half of the compressors may be operated with the condenser bypass valves set to inject hot gas into the liquid refrigerant in the flash cooler, thus heating the refrigerant until the vapor pressure in the cooler reverses the flow and supplements the suction maintained in the evaporator. The heat of compression available for heating refrigerant, piping, evaporator and melting frost accumulation on the evaporator is approximately 10,000 hp or 2100 tons.

An external two-stage economizer is provided for each compressor unit, which, when in use, will add approximately 56 per cent to the capacity of the machine when operating at the design condition of extreme head. It becomes necessary, however, under certain conditions of temperature in the cooler and suction pressure to the machine, to bypass the economizer so that return of refrigerant from economizer to cooler is possible. This function is performed automatically by pressure switches on the cooler and header.

A receiver of approximately 5500 gal capacity is provided for storing the refrigerant during the period between tests or for service on the main system. Auxiliary equipment is provided to maintain suitable temperatures of the refrigerant when in the receiver or when held in the main system. The two reciprocating compressors which serve this function may be operated in parallel or staged, depending on the temperature level required. They may also be used for purging air from the system should leaks arise, or to precool gasoline when the main plant is not in operation. Although each centrifugal compressor is equipped with its individual purge and recovery unit, it was felt desirable to supplement the standard units with larger displacement machines. This separate low temperature purge and recovery system will produce conditions which result in a very economical ratio of F-12 to air when purging.

The main refrigerating system may produce simultaneously the desired temperatures in the main evaporator, in an auxiliary evaporator and in the gasoline cooler or the shell-and-tube spray water cooler. Control of temperatures is obtained by a thermostat whose specially designed element is located in the path of the air leaving the evaporator and which in turn pilots a receiver or pressure controller located in the master control room. This pressure controller, which is responsive to output air pressure from the thermostat or transmitter, operates suction dampers to maintain desired evaporator temperature. A supplementary control of the suction damper is provided which reacts to compressor suction pressure. This pressure limit device is used merely to prevent overload of the compressor motor. Should suction pressure to the machine rise above a predetermined point, this instrument will automatically supersede the temperature controller and position the suction damper to maintain the maximum suction pressure.

Zig-Zag Arrangement of Coils

The main evaporator, as previously stated, consists of 260 plate fin-type coils. The coils have a total outside surface of 535,000 sq ft and a total face area of approximately 7700 sq ft. Under maximum conditions, 10,500,000 cfpm of air flows through these coils. Due to the limited space available for installing the surface required for the maximum load, the individual coils of the evaporator are arranged in a zig-zag pattern. This arrangement and optimum angle of approach were determined only after a careful study was made of the effects and the resultant losses when the air stream approach angle and the plate velocity were varied through a wide range.

The actual approach angle for this particular heat exchanger is 11 deg, thus permitting the installation of the required surface for the design load.

* Abstract of paper before both N. Y. and Cleveland Sections of ASRE, October 1944, published in Refrigerating Engineering, November, 1944.

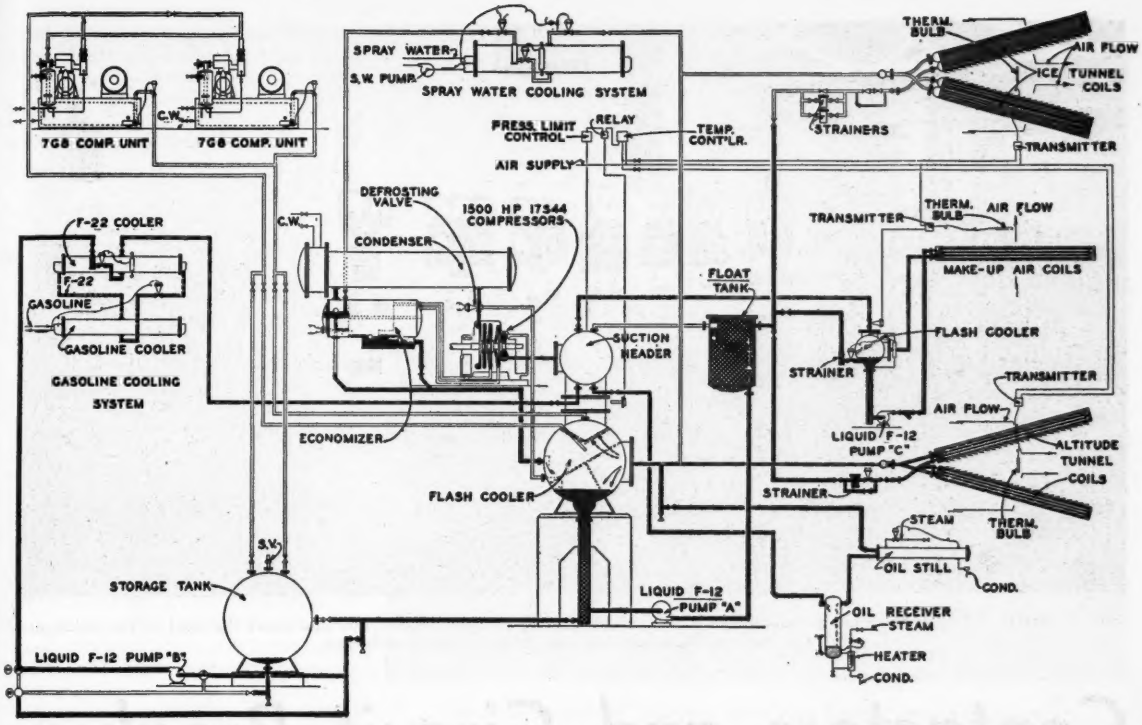


Fig. 1. Diagram showing connections of refrigerating equipment and auxiliaries in 21,000-hp, 7500-ton refrigerating plant serving Cleveland altitude test tunnel

Exit losses from the heat exchanger are reduced by special turning vanes or diffusers on the leaving side of the coils. These turning vanes increase considerably the recovery of the conversion losses when accelerating the air stream to the original tunnel velocity.

The two liquid lines serving the largest evaporators are 8 in. in diameter and made of copper-nickel steel. The suction line from one evaporator is a 45-in. diameter copper-nickel steel pipe, while the suction lines from the other main evaporator consists of four 32-in. diameter copper-nickel steel pipes.

Temperature differences in the piping make it essential to install some type of flexible connection which will permit movement during the extreme conditions of temperature. Special copper corrugated joints, equipped with tie-rods to take the thrust due to internal pressure under certain conditions, are used in sets of five to permit movement in both the horizontal and vertical planes. These joints will take only angular motion; hence the need for three in one plane, which produces the necessary "elbow action" while two others will permit the necessary movement in the vertical plane. Double "U" type bends in the liquid line suffice to take the movement in these 8-in. pipes.

A small rectifying unit or oil still is provided in case undue loss of oil results from the reciprocating units, the refrigerant pumps or the centrifugal compressors. Operation of the oil still is automatic except for draining the recovered oil from the receiver.

This is one of 11 installations falling under a general classification of "wind tunnels." They differ from each other in many respects. These installations serve tunnels which operate at atmospheric pressure as well as tunnels operating at variable densities in which supersonic velocities greater than four times that of sound are attained. The temperature obtainable in the test section of these 11 tunnels varies from —354 F to +140 F. A total of 53,000 installed horse power is required to drive the refrigerating compressors, and air compressors used in maintaining the wide range of desired test conditions.

Materials Used in Making Steel

SUCH familiar household stand-bys as salt, molasses, corn and bran are useful in the iron and steel industry for other than dietary reasons, according to the American Iron and Steel Institute. They are employed in large quantities in steel-making, and even sugar and soap can be used as an aid to production.

Salt is used in the rolling of steel plates to help break the scale from the surface of the slab, and from the resulting plate. Just before the slab enters the rolls, the salt is thrown onto it with scoops. The salt is carried under the rolls and brought into close contact with the hot metal which helps remove the scale. For the same purpose salt sometimes is used in the making of pipe. Salt has also been used in open hearth ladles as a fluxing agent to assist in rendering impurities more fusible. It has been used in mixer spouts to help prevent accumulations of iron.

In making castings, corn products and molasses are among the substances utilized to bind the sand used in foundry molds. Early in 1944 it was estimated that around 100,000,000 lb of corn would be required for metallurgical applications alone during 1944. Some producers have utilized corn lacquer in the processing of tin plate.

Bran middlings are employed by the steel industry in the manufacture of tin plate as an agent to help remove oil from the product. Other uses of cereals in steel plants are as inhibitors in the pickling process, in which various acids are employed to remove foreign substances from the surface of steel.

Soap aids the steel industry during the making of wire, which is brought down to the desired size through dies. Soap helps abate the tremendous friction created in the drawing process. Soap can be employed also to coat cartridge blanks before they are drawn into shape.

Another lubricant which has been utilized in the steel industry is suet. It has been used upon both rolls and dies.

Pure corn sugar, blown onto the inner surface of ingot molds can be used to help prevent splashed metal from solidifying on the walls of the mold. It is applied by a process patented several years ago.

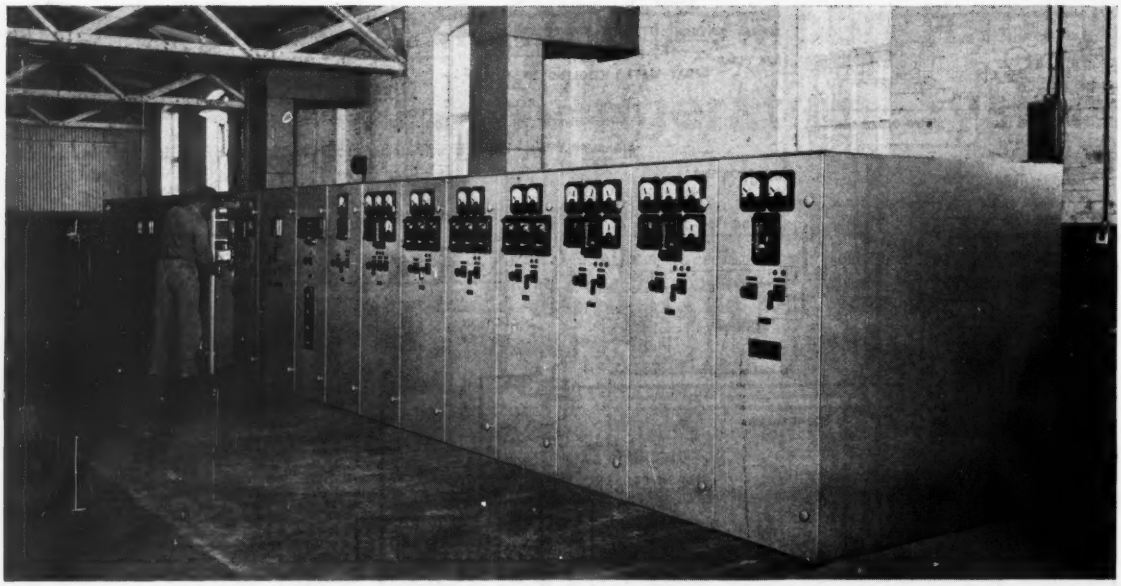


Fig. 1. Metal-clad switchgear using Magne-blast circuit breakers in an industrial plant. This view shows the front of the switchgear and the metal-enclosed bus runs to the power transformers

Contactors and Circuit Breakers As Switching Mechanisms

By G. R. Prout*

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THERE seems to be some misunderstanding on the part of many people with respect to the application of circuit breakers and contactors as switching mechanisms in different kinds of circuits. Perhaps an analysis of the primary applications of these devices as switching mechanisms might help to clarify this situation.

There is a large requirement in power generation, power sub-station, and power distribution circuits for switching devices to handle current under normal load, as well as under emergency conditions brought about by short circuits or grounds. Circuit breakers are designed primarily to meet the requirements of this application.

As a typical installation, let us consider the application of a switching device to a power distribution circuit. Usually this circuit leaves the controlling switching device, goes out of the generating station onto overhead line construction, frequently for some appreciable distance, and serves a large number of loads on various customers' premises. It is essential that these feeders be "hot" 24 hours each day, 365 days each year, so as to furnish power at all times to all power users. On this application, the switching mechanism operates relatively infrequently as a device to open and close the circuit under normal operating conditions.

On circuits of this kind, however, the probability of fault is relatively high. Overhead construction is exposed to lightning, the destruction of insulators by boys armed with guns, falling tree limbs, and other hazards, any one of which cause faults on the line. While each load served from the feeder will have its own fault-protection device, it is recognized that faults in power users' plants may cause feeder breakers to trip back at the generating plant or at the substation. Therefore, an increase in the number of customers served from the feeder increases the probability of fault and perhaps somewhat in proportion to the number of power users involved.

With these points in mind, it is obvious that the switching mechanism controlling a feeder circuit often may be called upon to operate under fault conditions.

Usually, an appreciable amount of current will flow under fault conditions, and the switching mechanism must have capacity for interrupting the circuit under these conditions without damage to itself. Interrupting capacity is, therefore, a very important feature of a switching mechanism for this application.

Frequently, circuit breakers in the same circuit may be relayed for sequential tripping to limit the outage from a fault to a minimum part of the connected load. Such time-delay tripping requires that the circuit breaker is able to carry that current which would flow under fault conditions until the circuit is opened. In order to meet this requirement as well as that of initial fault current flow, short-time carrying capacity is also an important requisite of a switching mechanism for this application.

Circuit breakers (Figs. 1 and 2) are designed primarily to meet the above type of requirements. Usually, in the design of switching mechanisms having the required interrupting ability and short-time carrying capacity, high tip

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pressures are necessary. Such pressures require relatively heavy operating mechanisms having considerable inertia, which usually means severe shock loads when operating. Therefore, circuit breakers, generally, are not designed primarily for frequent, repetitive mechanical operations. The requirements of the above application with respect to life, however, are met very adequately when present-day circuit breakers of proper ratings are applied. Usually circuit breakers are not applied where frequent operation or repetitive service is required.

Since it is essential to have power generation and distribution circuits "hot" as nearly 100 per cent of the time as possible, and also since switching mechanisms in such circuits must be inspected and serviced periodically, it is very important that the switching mechanism is installed in the circuit so that it can be replaced in the absolute minimum of time. There are emergency conditions, too, where it is highly desirable to be able to substitute a replacing mechanism in the minimum of time. Therefore, an "easily replaceable" feature provided by such a switching mechanism is extremely desirable.

Reliability of operation under all conditions is essential. Protection of the circuit and its load is necessary, and safety to operators, and to other equipment which may be installed adjacent to this switching mechanism, is important. Circuit breakers are designed primarily to do this job, and they do it exceedingly well.

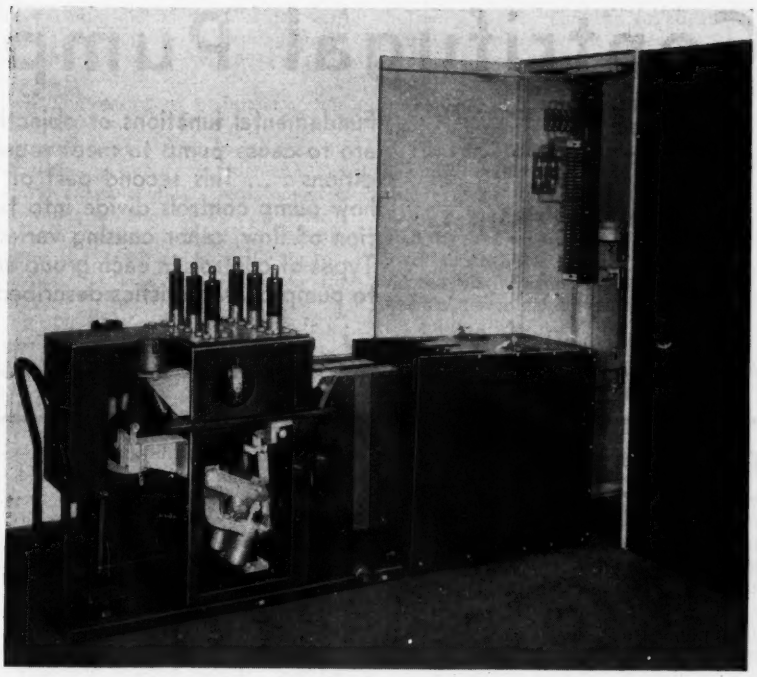

Fig. 2. G-E metal-clad switchgear with circuit breaker removed for inspection and maintenance

In motor circuits, too, a switching mechanism is necessary. The requirements for a motor-circuit switching mechanism, however, are usually quite different from those for a power-circuit switching mechanism. Contactors are designed primarily to meet the requirements of this application (Figs. 3 and 4).

The switching mechanism in a motor circuit controls a single motor. Usually,

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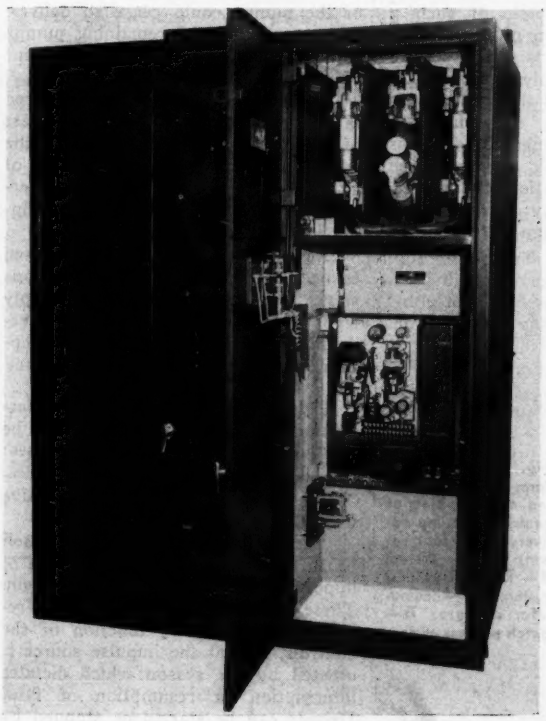

Fig. 3. Front view of metal-enclosed, 2300-v synchronous motor controller, showing current-limiting fuses for providing short circuit protection. These fuses also serve as a disconnecting switch when the controller or motor is being inspected or serviced

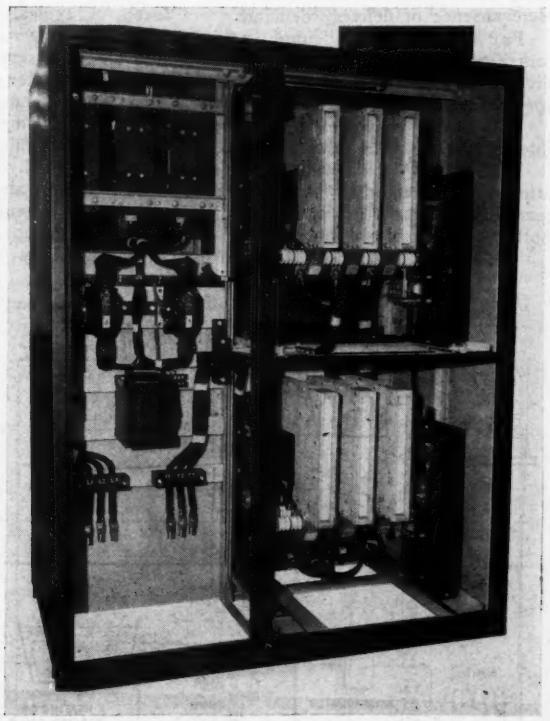

Fig. 4. Rear view of metal-enclosed 2300-v synchronous motor controller using air-break contactors and current limiting fuses. The air-break contactors provide long life and are readily accessible for inspection and servicing

Centrifugal Pump Control

Part II

Fundamental functions or objectives of centrifugal pump control are to cause pump to meet required variations in operating conditions . . . This second part of four-part article shows why and how pump controls divide into two groups: one causing interruption of flow, other causing variation of operating conditions . . . Types of controls in each group and what they do . . . How related to pump characteristics described in Part I, December, 1944 issue

By Igor J. Karassik — *Application Engineer, Worthington Pump & Machinery Corp.*

OPERATION of a centrifugal pump partakes of the attributes of a continuous rather than of a batch process. In the great majority of cases pumps are operated continuously in a system for relatively long periods of time. In many cases, the only possible cause for interruption arises either from some mechanical defect in the system or in the pump itself or from a scheduled examination and overhaul. Nevertheless a certain amount of flexibility in operating conditions always exists and, in some cases, rather extreme variations may be encountered. The fundamental functions of centrifugal pump controls are, therefore, directed towards permitting the pump to meet the required variations in operating conditions, includng the complete absence of delivery demand.

For the purpose of simplification, centrifugal pump controls may be subdivided into two main groups with respect to their function:

I. Controls which cause complete interruption or resumption of flow.

II. Controls which vary the operating conditions, that is either the pump capacity or the total head or both.

These main groups are indicated in the accompanying table and the subdivisions are summarized and lettered to correspond with those in the following text.

Interruption Controls

The reasons which may require starting or stopping pump delivery are of an extremely varied character and the list which follows must be considered as representative rather than exhaustive. It may become necessary to stop delivery if:

1. The source of supply has been completely drained, or at least drained to the desired level. This is generally the case with sump pumps, with mine gathering pumps or with tank-car emptying pumps, as shown in Fig. 1A.

2. The vessel into which delivery is made has been filled to the desired level. A typical example of such a reason for interruption of flow is the filling of a reservoir tank for service or drinking water supply, as in Fig. 1B.

3. The pressure of the system into which the pump is delivering has reached its required magnitude. This is typical of hydraulc systems with dead-weight or air bottle accumulators, although it is generally desirable to so select the pump design capacity and the accumulator size with relation to the maximum and average demand that the pump capacity stays within reasonably narrow limits in the neighborhood of its design magnitude. See Fig. 1C.

4. A batch process served by the pump has been completed. The application of centrifugal pumps to heat transfer through recirculation is representative of this requirement, Fig. 1D. Another example is the use of centrifugal pumps in a steel rolling mill descaling system, where delivery through the descaling nozzles is interrupted between consecutive steel sheets.

5. A system is served by a battery of several pumps operating in parallel and the required rate of flow has decreased to a point where one or more of the pumps could cease to deliver, so as to permit the remaining pumps to operate at a more economical point of their characteristic curve.

6. Mechanical trouble has occurred in the pump, its driver or in some part of the system. This may include the overloading of a driver, overheating of an electric motor or of the pump, overspeeding of a steam turbine, burst piping in the system, etc.

Resumption of flow must be caused to occur when the reverse conditions arise, such as an increase in the supply level, reduction of delivery level, reduction of system pressure or resumption of the batch process.

Types of Interruption Controls

These controls which cause interruption or resumption of flow can be subdivided into two separate classes:

A. Start or stop of the driver.

B. Opening or closing of a valve in the path of the flow.

Each of these two classes can itself be further subdivided as to source of impulse and controlling medium. These subdivisions are obviously related to the primary function of the controls, in that the impulse source is created by the reason which dictates interruption or resumption of flow. Drivers can be started or stopped by means of:

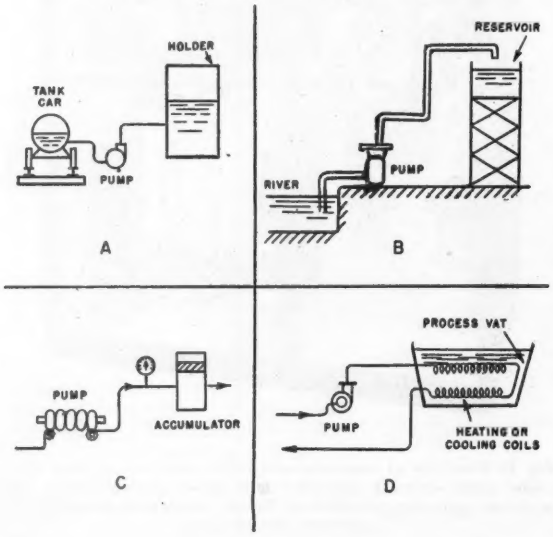

Fig. 1. Typical systems requiring starting and stopping of centrifugal pump delivery. A—Tank-car emptying system B—Reservoir-filling system. C—Accumulator system. D—Batch process system

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excessive pressures may be imposed on the suction piping and fittings. A check valve is fully automatic in its operation, closing when adverse conditions occur and reopening immediately on the resumption of normal conditions.

c. Float control valve. The variation in suction or discharge levels can be transmitted to a mechanically or electrically operated valve in the pump discharge so as to fulfill basically the same function as a float switch.

d. Pressure control valve. This form of control bears the same relation to the pressure switch as the float valve bears to the float switch. There is, however, one specific application which differs somewhat in its fundamental function, namely the use of pressure control valves as relief valves. A great number of installations require this form of protection, either against the building up of excessive pressure through operation at very reduced flows, or against the overloading of a driver in the same range of operating conditions when the power consumption curve rises sharply with the head developed.

e. Thermostat control valve. This again utilizes temperature variations to close or open discharge valves instead of operating on the driver itself.

The last three control applications are relatively rare, except in the case where they perform the added function of modifying the pump operating conditions over a wide range and where they incidentally are permitted to travel to the full closed position should the externally imposed conditions require it. This phase of their operation will be considered later. It must be remembered, however, that a centrifugal pump should never be permitted to operate against a completely closed discharge and that a by-pass recirculation line must be provided whenever valve positioning control may fully interrupt flow delivery. (By-pass protection control will be discussed elsewhere in this series of articles).

Variation of Operating Conditions

The reason which may call for a variation in the operating conditions are as multifold as those which may require interruption of resumption of flow. To cite but a few, these reasons may be:

1. The desire to maintain a constant level, either in the suction or discharge reservoir, irrespective of the variation of supply or demand. A typical example of this requirement is the modern boiler feedwater system, where a constant boiler level must be maintained, irrespective of the fluctuation of the load imposed upon the boiler.

2. The desire to maintain a constant rate of flow under varying conditions of static elevation difference between the source of supply and the ultimate delivery. Such conditions occur most frequently when a centrifugal pump takes its suction from a body of water subject to tidal variations.

3. The need to maintain a constant pressure in a system, or a constant pressure margin over some specific pressure, irrespective of the total flow into the system.

4. The need to maintain a constant temperature in a batch process by means of cooling or heating through heat exchangers, irrespective of temperature variations in the cooling or heating medium.

Since the operating conditions of a centrifugal pump are established by the intersection of the head-capacity curve at the operating speed and of the system head curve, it follows that variation of the operating conditions can be obtained by either one of two methods: (See table).

A. Modification of the pump head-capacity curve.

B. Modification of the system head curve.

Modification by Speed Variation

Except in some very rare applications where the pump head-capacity curve is modified through mechanical changes of the interrelation of internal pump parts while in operation and which will be discussed later, the modification of the head-capacity curve is accomplished by means of variation in the pump speed. This can be effected either by modifying the speed of the pump driver itself or by applying a variable speed power transmission mechanism, such as a hydraulic coupling or a magnetic power transmission.

The controlling mechanism itself is generally unaffected by the choice between these two forms of speed change. This choice is generally dictated by the choice of the type of driver best suited for the installation and the relative economy of the several possible driver combinations. If electric motors are used, variable speed operation can only be obtained with d-c motor or a-c slip-ring, wound-rotor motors. In a few isolated cases, squirrel-cage induction motors can be operated at variable speed through frequency variation, but this arrangement is as yet little used. Steam turbines and internal combustion engines lend themselves most conveniently to speed variation and therefore are seldom connected to the driven pump by means of variable speed transmission mechanisms.

Methods of Controlling Speed

Pump operating speeds may be controlled by means of:

a. Manual control. This may require a rheostat for motor driven units, or a throttle valve control for steam turbines and internal combustion engines.

b. Flow control. Such a control is generally based on the desire to maintain a constant flow despite variations in the system head curve. The control speeds up the pump whenever the intersection between the head-capacity and system head curves falls below the desired value and slows the pump speed in the contrary case.

c. Float or level controls. The principle of operation here is similar to that of float switches, except that instead of a start-and-stop action, they perform the continuous, function of slowing down and speeding up the pump to maintain the desired level.

d. Pressure control, as exemplified by constant pressure steam turbine

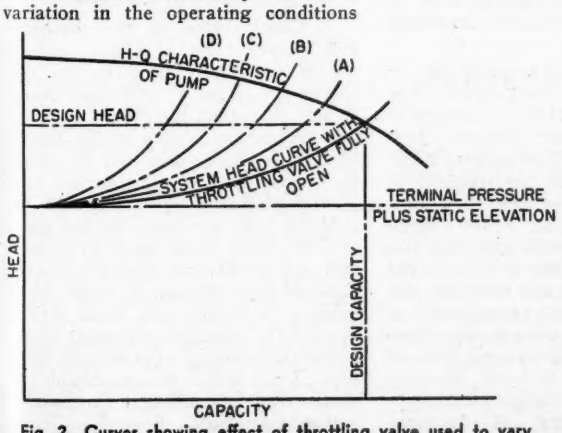

Fig. 2. Curves showing effect of throttling valve used to vary pump capacity

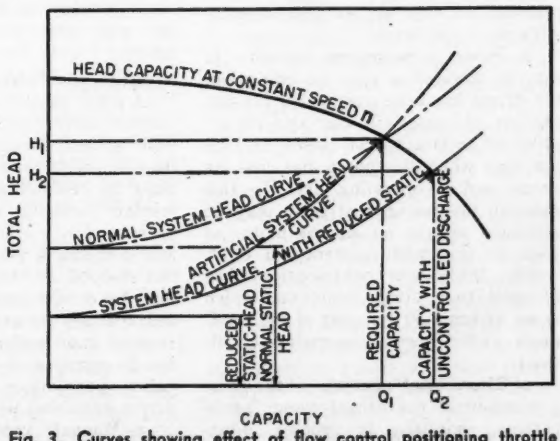

Fig. 3. Curves showing effect of flow control positioning throttle valve to maintain required flow under reduced static head

a. Push-button control, for electric motors. This method of course, answers a multitude of requirements as it only requires that the operator be acquainted in proper time of the necessity of flow interruption or resumption.

b. Float switches. These may be applied to maintain certain predetermined maximum or minimum levels in tanks or reservoirs into which fluid is discharged by electric motor driven centrifugal pumps. In such an application, an electric contact is made by means of the float switch when the level in the reservoir has been reduced to the predetermined minimum, starting the pump motor. As the level reaches the predetermined maximum, the contact is broken and the pump is brought to rest. In the event it is desired to control the operation of the pump by means of the level on the pump suction side, the operating mechanism is reversed so that the pump is started at a given high level and brought to rest when the desired minimum is reached. The same function may also be performed by means of contact switches, where electrical circuits are made or broken by changes in liquid levels.

c. Pressure switches. These switches are similar in principle to the float switch, but operate on changes of pressure and are used to maintain pressure in a system or in a closed tank within certain selected limits. The pressure to be controlled is generally applied to a diaphragm actuating the switch. When the pressure falls to the minimum, the pressure on the diaphragm is reduced, making an electrical contact and starting the motor, which in turn is stopped when the pressure has arisen to the desired magnitude, breaking the contact.

In certain cases, pressure switches can be used interchangeably with float switches, as they can be made to maintain level in reservoirs or tanks. One method consists in utilizing the static head of the fluid in the reservoirs as a source of varying pressure. Another method consists of trapping a quantity of air in a closed tank, the pressure of this air varying directly with the liquid level.

d. Power consumpton control. It may be directed to stop the unit when the driver has been overloaded for any number of causes. It can also be applied in certain special cases to stop the unit when the pump has lost its prime and is operating dry. In this case, an inverse current relay may be arranged to stop an electric motor as soon as the input current (in other words, the power consumption) has dropped to a given minimum, which is set at some 50 per cent of the minimum under normal operating conditions.

e. Thermostat control. There exist a number of centrifugal pump applications, especially in process industries, where certain definite temperatures are to be maintained or reached by means of heat transfer, recirculation, etc. In such case, a thermostat control may be applied in the same manner as a float or a pressure switch, but substituting temperature levels for either static levels or pressure differences.

f. Overspeed governor. These are applied mainly to steam turbine drivers, although they can also control internal combustion engines or even water turbines used to drive centrifugal pumps. They are intended to protect the driver, the pump and the system in which the pump is operating. The last two could become endangered if the driver should possess sufficient power to drive the unit at speeds sufficiently high to cause excessive pressures. A typical example of this form of control is the overspeed governor which acts on the inlet valve of a steam turbine and which is generally set to trip the turbine out, if the operating speed exceeds 5 to 10 per cent over the design operating speed.

Table Showing Summary of Centrifugal Pump Control Functions

FUNDAMENTAL CONTROL FUNCTIONS

- **I—INTERRUPTION AND RESUMPTION OF FLOW**
  - **A) START AND STOP OF DRIVER**
    - a) Push button on motor
    - b) Float switch
    - c) Pressure switch
    - d) Power consumption
    - e) Thermostat
    - f) Overspeed governor
  - **B) VALVE POSITIONING**
    - a) Manual valve control
    - b) Check valve
    - c) Float or level control
    - d) Pressure control
    - e) Thermostat
- **II—MODIFICATION OF OPERATING CONDITIONS**
  - **A) MODIFICATION OF PUMP H-Q CURVE THROUGH SPEED VARIATION**
    - 1) Driver speed control
      - a) Manually
      - b) Flow control
      - c) Float or level control
      - d) Pressure control
      - e) Temperature control
    - 2) Power transmission control
      - a) Flow control
      - b) Float or level control
      - c) Pressure control
      - d) Temperature control
  - **B) MODIFICATION OF SYSTEM HEAD CURVE THROUGH VALVE POSITIONING**
    - a) Manually
    - b) Flow control
    - c) Float or level control
    - d) Pressure control
    - e) Temperature control

Interruption Without Stopping Unit

A great number of installations may require interruption and resumption of flow without stopping the unit. This may be called for either because variations in demand are too frequent to warrant bringing the unit to a stop, because driver starting is too lengthy and complex a process, once the unit has stopped, or because interruption of flow by driver stoppage does not prevent certain injurious effects, such as reverse flow through the pump. Flow can be resumed or interrupted through valve positioning without affecting driver operation by means of:

a. Manual control of discharge valves. Certain installations require that the unit be operating at all times as a safety measure, even though there be no demand for flow delivery. A gate, globe or plug valve located in the pump discharge can be used to cut off the flow entirely through manual manipulation. This is a frequent arrangement when several units are operating in parallel and when one or more of the units are installed for standby duty. This form of control requires the use of a by-pass, to prevent overheating of the pump when operating at shut-off. It should be considered that in many cases, especially with across-the-line electric motor starters, the unit can be put on the line by starting the motor quicker than by manipulation of a valve in the discharge and, therefore, when the time element is important, start and stop of the motor is much to be preferred. Likewise, manipulation of discharge valves, if carried out too quickly, is more conducive to water hammer than the start and stop of the driver.

b. Check valve in the discharge line. Some form of check valve is almost universally used in the discharge line from a centrifugal pump. It acts to protect the pump, its driver and the suction portion of the system against damages which may be caused by reverse flow, if the external head in the discharge system should exceed the head generated by the pump or if the pump should come to a standstill and develop no head whatsoever. Reverse flow through a pump would cause it to operate as a water turbine running in direction opposite to the normal direction of rotation and, therefore, if the driver is not suitable for this reverse operation, it can become seriously damaged. Even if no harmful effects befall the pump or its driver,

regulators which maintain at all times an operating speed which will result in a constant discharge pressure, regardless of flow variations.

e. Temperature control. The function of this type of control is to increase or decrease the pump delivery in order to maintain a constant rate of heat exchange, despite temperature variations between cooling and cooled medium.

Modification by Valve Positioning

In the majority of installations, however, it is either impossible or impractical to change the pump operating speed and in order to alter the operating conditions, it is necessary to alter the shape of the system head curve by varying one of its components. In this case, neither the terminal pressure nor the static level difference can be expected to permit variation. The only possible solution lies in the variation of the friction head loss in some part of the system. It becomes necessary to introduce an artificial source of friction loss, such as a valve, this friction loss being controllable through valve positioning by the quantity—capacity, pressure, level or temperature, it is desired to control.

Figure 2 illustrates the operation of a centrifugal pump at constant speed and the effect of a throttling valve used to vary pump capacity. The design capacity is obtained with the throttling valve fully open, while curves (A) to (D) represent the system head curves corresponding to several positions of the valve, progressively closing. Thus, depending on the required capacity and consequently on the position of the throttling valve, the pump operating conditions will correspond to the intersection of the head-capacity curve with curves (A) to (D) or with any intermediate curve.

Methods of Valve Positioning

The positioning of the throttle valve may, in its turn, be controlled by:

a. Manual control. This is the most widespread application and is used when operating conditions are expected to require infrequent changes. The pump operator progressively closes or opens a gate or globe valve in the pump discharge. It should be added that throttling the pump suction is seldom recommended, because equally or even more satisfactory results can be obtained by controlling the discharge without running the risk of pump cavitation.

b. Flow control. The application of this control to the positioning of a throttling valve is illustrated in Fig. 3, where this valve is automatically operated to maintain the flow at its desired magnitude when the static head is reduced and therefore the uncontrolled system head curve would intersect the pump and head-capacity curve at an increased capacity.

c. Float or level control. The operation is similar to that directed at varying pump speed, except that the level is maintained by artificially altering the system head curve. The boiler feedwater regulator is a typical example of this application. Its operation is exactly as that shown in Fig. 2, with the terminal pressure being equivalent to the boiler pressure.

d. Pressure control. The pressure regulator operates in a manner similar to that of the flow or level regulator, except that a constant discharge pressure at the pump is maintained by throttling off the excess pressure as capacity demand varies.

e. Temperature control. The most common application of this control is to cooling or refrigerating systems, when the type of driver does not permit speed variation.

Except for the fact that these controls are intended to provide several dissimilar services, such as start-and-stop of the driver, modification of the pump head-capacity curve or modification of the system head curve, they are all based on a group of similar impulse sources: flow, level, pressure or temperature. This similarity is most forcefully illustrated in the appended tabular analysis of the fundamental control functions. The next article will therefore deal with the subdivision of control functions into impulse sources, methods of impulse relays and terminal control operation, that is the change of whatever relationship may be required, such as valve setting, pump speed, etc.

(*To Be Continued*)

Contactors and Circuit Breakers as Switching Mechanisms

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the wiring between the switching mechanism and a 2200 v motor is varnished-cambric insluated, lead-covered cable in conduit. For low-voltage motors, suitably insulated conductors in conduit are generally used. The distance between the switching mechanism and the motor is usually relatively short. Considering the overall installation, therefore, the probability of fault in such a circuit is comparatively small. Fault-protecting devices are, nevertheless, necessary in the circuit and must be provided. If a fault occurs, however, it is not particularly necessary that the fault-protecting device should be capable of being quickly and easily reclosed or replaced because an appreciable length of time is usually required to repair the fault and the motor cannot be operated until the fault is repaired.

The requirements of switching mechanisms in motor circuits vary widely with respect to frequency of operation. Many motors start and stop only two or three times a day; some may start and stop only once in 30 days; many others are starting and stopping every thirty minutes, or even more frequently. There are requirements for reversing, dynamic braking, and plugging, all of which impose severe operating conditions on the switching mechanism in motor circuits.

Since industry uses a very large number of motors for all kinds of purposes, it is impracticable, if not impossible, to check the application with respect to frequency of starting for each motor which is furnished to industry. If it were practicable to do so, there still would be no assurance that the duty cycle in a particular case would not be changed at some later date.

The general requirement, then, is that the switching mechanism furnished in a motor control unit must have long life, so that it operates successfully even under repetitive service conditions. The contactor is designed, basically, as a switching mechanism for use in motor circuits and, therefore, has long life. Its mechanical life may be more than one hundred times as great as that of a circuit breaker.

Since long mechanical life is so essential, low tip pressures are used so that the operating mechanisms are light and the inertia of moving parts is low and, hence, the shock loads are light.

A short-time current rating is incompatible with low tip pressures, and interrupting ability tends to be low. These characteristics can be safely sacrificed to obtain the more important functional requirement of long, reliable service under frequent starting duty, because combination control units using contactors and properly co-ordinated emergency fault protecting means are available.

Since contactors usually have low interrupting ability but are frequently used in circuits where relatively high current would flow under fault conditions, it is necessary to protect them and the circuit by some adequate fault-protecting device. However, in the application of such a fault-protecting device, consideration should be given to the probability of fault and its magnitude, as well as to the interrupting ability, reliability, speed, and consistency of operation of the fault-protecting device.

In applying fault-protecting devices ahead of contactors in motor circuits where relatively high currents will flow under fault conditions, it should be remembered that circuit breakers will pass the maximum peak current that will flow under fault conditions before opening the circuit. Since the short-time current-carrying ability of contactors of conventional design is low, circuit breakers do not adequately protect them under such fault conditions. Complete control units in which properly co-ordinated fuses, contactors, relays, current trans-

(*Continued on page* 124)

More Steam Without New Boilers

North American Rayon gets additional steam capacity, to meet increased industrial process demands, by alterations and additions to existing steam generating units . . . New induced draft system has sufficient capacity for all boilers now installed . . . Alterations in stokers and furnaces of two units increases fuel burning capacity of the plant

By M. F. Freeman

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THE NORTH AMERICAN RAYON CORP. operates a plant at Elizabethton, Tenn., for the manufacture of rayon yarn. The process is basically continuous and offers a very uniform power and steam demand. Adversely, such a load offers no week-end or low load periods allowing inspection and maintenance of units. Maintenance must be carried on without dropping load.

The plant has recently been extended to provide facilities for making rayon cords for use in automobile tires. The plant extension increased steam and electric loads to a point which exceeded the existing boiler plant capacity, and it was necessary to provide additional steam generation at reasonable cost with minimum use of critical materials, and without undue interference with operation.

The plant contains eight 833-hp Stirling boilers, each equipped with Westinghouse multiple-retort underfeed stokers. Two boilers, No. 7 and No. 8, are equipped with extension grates and water-cooled bridge walls. The stokers for boilers No. 1 to No. 6, inclusive, were designed for 200 per cent rating and those on No. 7 and No. 8 for 225 per cent rating. Air is supplied to the wind box of each stoker by steam and electric-driven forced draft fans. Gases were taken by natural draft through a flue to a stack and thence to the atmosphere. Available draft limited the steam output of the boiler plant. Boilers No. 7 and No. 8 were limited to 180 per cent rating when other boilers were operating.

Original Design of Plant

The plant was built with four boilers in 1928; two boilers were added in 1929 and two in 1937, making a total of eight boilers. The extensions have been made without addition of a stack or other draft equipment. The plant is an example of a well-engineered and designed plant for the period of 1927-1929. The arrangement of the boilers and stokers with natural draft and forced draft fans for a top rating of 200 per cent was the general custom at that time. Water walls were not generally used and heat liberations per square foot of stoker were moderately high, but the heat liberation per cubic foot of furnace volume of the Stirling boilers was relatively low. Fortunately, the Stirling boilers were set with the mud drum high, 10 ft above the firing floor. This was a tendency becoming evident in 1928 and was later more pronounced, especially with the advent of water cooling.

The output of plants of this design cannot be increased materially except by the installation of induced draft fans or additional stack capacity. A stack to increase draft for higher rating on boilers would require a greater height than that of the existing one and a stack extension is usually impractical unless provided for in the original design. Operation with one tall and one short stack would introduce difficulties in obtaining proper draft for the several boilers. An induced draft fan installation requires power (either steam or electric) but it can provide sufficient draft to permit suitable regulation for the entire boiler plant. The type of driving unit is determined by economics and dependability of operation.

After providing adequate draft, it is still necessary to increase fuel burning capacity. With this type of equipment, burning more coal requires additional grate area in the stokers. Stoker areas may be increased without major furnace rearrangement only by adding extension grates. The extension grates will also reduce the combustible content of the ash rejected to the ash pit. Such a change should be accompanied by a redesign of the furnace involving water cooling.

How Output Was Increased

By increasing draft and adding extension grates for stokers, one obtains

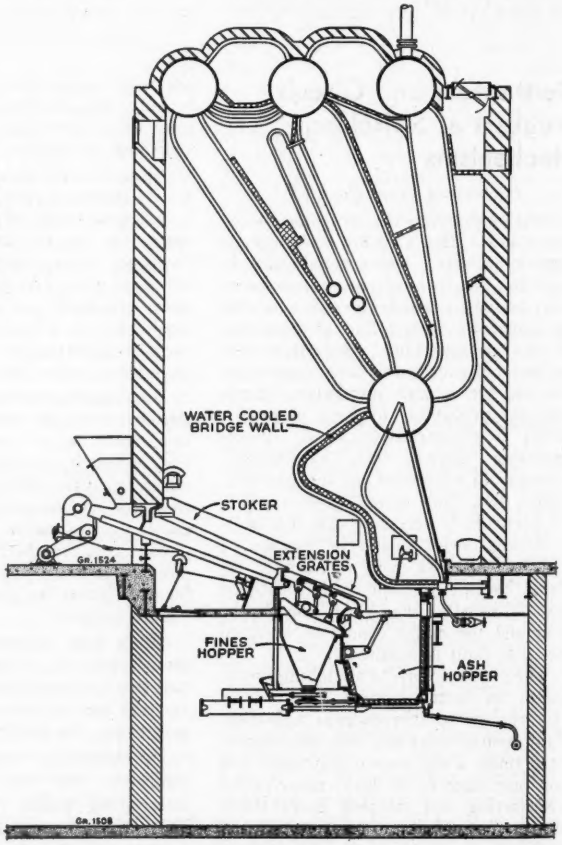


Fig. 1. Cross-section through one of the Stirling boilers after alterations, showing stoker extension grates and water-cooled bridge wall added to the unit

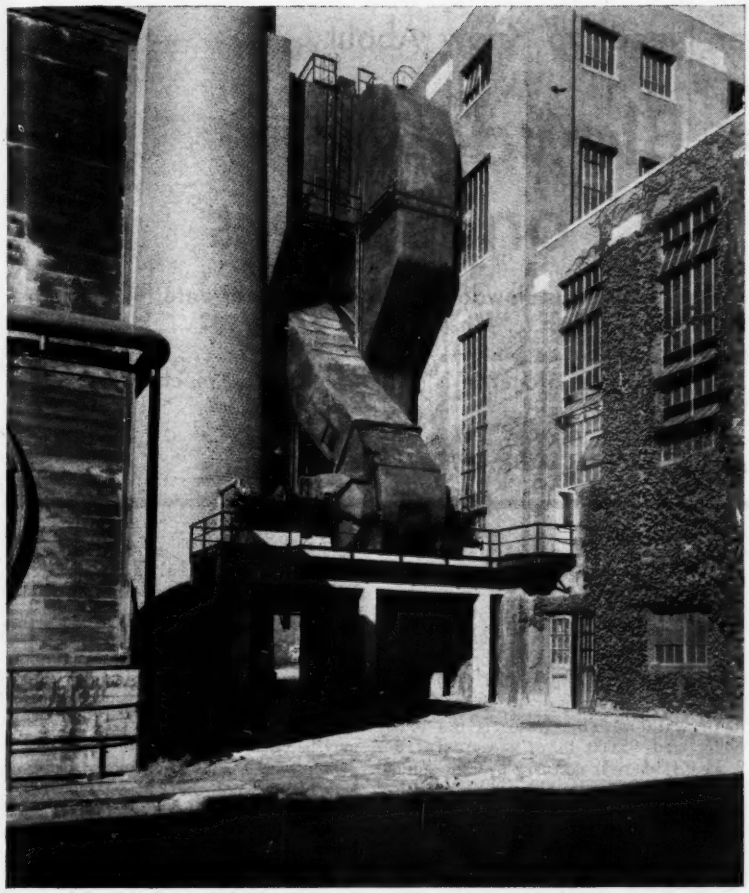


Fig. 2. View of new induced draft system, installed just outside boiler room, showing south induced draft fan, steam turbine drive, ductwork

some of the more desirable features in the design of a modern plant, at the same time retaining the large steam relieving areas, the liberal heating surfaces and circulation of the older style equipment. Heat recovery equipment may be added to improve plant efficiency, and such equipment would probably be installed in a new plant, offering increased efficiency, but under the present circumstances the main objective in this plant was increased capacity and no heat traps were added.

The boilers at the plant of the North American Rayon Corp. are well adapted to the changes described to increase its capacity.

New Draft System

The draft increase is provided by two American Blower Corp. steam-turbine-driven induced-draft fans placed between the building and the stack, as shown in Fig. 2. The gases are withdrawn from the main flue at the boiler plant side of a new damper and discharged to the stack side of the same damper. Each fan has capacity to allow production of the expected steam requirements. The present capacity of each fan is 465,000 lb per hr of gas at 700 F against resistance of 2.5 in. of water. Each fan will handle 630,000 lb per hr of gas, against 2.06 in. of water. Each fan may be speeded up for future load to handle 885,000 lb per hr of gas against 2.6 in. of water.

The fans are located out of doors on a platform at the firing floor level of the boiler house, thus being conveniently available to the firemen and operating crew at the firing floor level. Each fan is equipped with dampers allowing removal from service for maintenance. Each fan is driven through gears by a 250-hp steam turbine, which exhausts to the factory process lines operating at 12 psi gage. These driving units, each consisting of turbine and gears, were supplied by Worthington Pump & Machinery Corp.

The choice of turbines was based on economics and dependability of service. Valves permitting hand regulation of fan speed are inside the building. Space is available for future automatic control valves, if desired.

Stoker Modifications

Stokers for two boilers were modified by adding extension grates, thus providing greater stoker area and more efficient equipment for completing the combustion of fuel. These extensions are the manufacturer's standard for the particular stokers involved.

Water-cooled bridge walls were also added to increase the furnace cooling and to provide more intimate mixing of air and gas for combustion. The bridge wall is a "Roman-nose" shape, which causes air and gases from the dump end of the stoker to sweep away from the wall into the fire directly above the stoker. This shape of wall is also not subject to the slagging difficulties of a vertical wall. The setting as it now exists is as shown in Fig. 1.

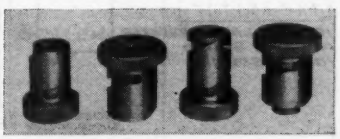
Similar changes can be made, when required, on four remaining boilers, increasing their rated capacity from 200 to 275 per cent. The two fans have ample capacity combined to provide sufficient draft for all boilers. The fans may be speeded up, if larger driving units are provided, to permit carrying the total capacity with one fan.

The plant after changes is an example of a well modernized plant. Further changes when justified may be made by installing economizer elements to increase further both boiler capacity and the plant efficiency. The fan capacity will be sufficient as the reduction in volume of gas due to a reduction in its temperature more than offsets the increase in draft.

The engineering study, design of the alteration and construction work were handled by Stone & Webster Engineering Corp., in cooperation with Paul A. Chapman, acting plant manager, and Ronald J. Martin, superintendent of power, of North American Rayon Corp.

Self-Locking Bushings

SPIRAL-GROOVED, self-locking bushings, devised by the Planning and Wage Payment Department at General Electric's Erie Works, are adaptable to any fixture with members large enough to accommodate liner and slip bushings. The bushings provide a positive locking feature which insures an efficient and accurate means of drilling, reaming, and broaching brush-holder locating holes in motor magnet frames to extremely close tolerances.



The bushings are of various sizes. They are hardened, and precision ground with a spiral groove incorporating a flat at the top which interlocks with a hardened pin inserted in the liner jig. The clockwise rotation of the drill, which holds the bushing in position, prevents it from being forced out of the jig during the drilling operation. The drill is well piloted and will not deflect or run, thus eliminating the possibility of drilled hole mislocation.

The conventional slip type bushing was ejected from the liner bushing by chips, allowing the cutting tool to deflect. This resulted in holes being drilled, reamed, and broached out of location.

What the Power Engineer Needs to Know About

Continuous Blowdown on Boilers

What Continuous Blowdown is for . . . How to determine whether you need it or not . . . What equipment required? . . . How installed on various types of boilers . . . How it operates . . . How to control it . . . What maintenance is required . . . How much does it cost?

By Robert T. Sheen

Associate Director, Consulting Division
W. H. & L. D. Betz, Philadelphia, Pa.

PRACTICALLY ALL NORMAL WATERS used for boiler feed purposes contain dissolved solids. As a water is fed to a boiler, steam, free of solids, is liberated, the solids remaining behind and concentrating in the boiler water. Certain of the solids become insoluble or are precipitated by the addition of chemicals in the form of sludge, but it becomes necessary that the solids be removed from the boiler water *at the same rate* at which they are introduced, to avoid a build-up of solids to the point where they will pass over with the steam. The purpose of blowdown, therefore, is to remove these solids at the same rate at which they are introduced to the boiler.

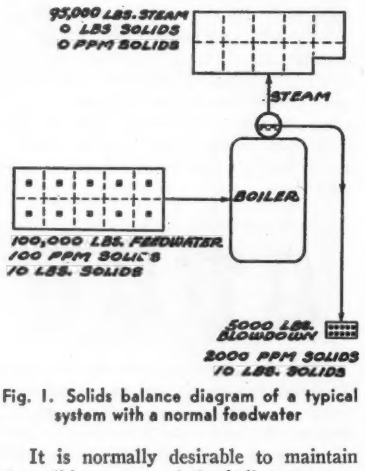


Fig. 1. Solids balance diagram of a typical system with a normal feedwater

It is normally desirable to maintain the solids content of the boiler water as high as possible to keep the volume of blowdown water at a minimum and thus to avoid loss of treated water as well as of heat. The amount of blowdown required to maintain suspended and dissolved solids at or below the maximum desired concentration will vary with an individual plant because it is dependent upon:

(1) Amount and type of solids in feedwater.
(2) Type of internal treatment.
(3) Operating boiler pressure.
(4) Boiler design.
(5) Rate of evaporation.
(6) Load characteristics.

Figure 1 is a schematic illustration of a typical system showing a normal feedwater with 100 ppm of solids (100 lb in 1,000,000 lb of water or 10 lb in 100,000 lb of water). This water is fed to a boiler and 95,000 lb of steam are removed, if there is no carry-over of solids with the steam, with "zero" content of solids. The 10 lb of solids in the feedwater are therefore removed by means of the blowdown in 5000 lb of water. This concentration of solids in the smaller quantity of water is equivalent to 2000 ppm, but the important point is that the same number of pounds of solids had been removed by the blowdown as was introduced with the feedwater in the same unit of time.

It is possible to remove these solids by intermittent operation of the bottom blow-off valve, removing 5000 lb of blowdown by one or more openings and closings of the bottom blow-off valve. When this is done, an inrush of feedwater following the blowdown is required to make level in the boiler, and the operating concentration is thereby reduced appreciably below a maximum that can be safely maintained as shown in Fig. 2. With intermittent blowdown, a concentration as illustrated at "C" may be reached, resulting in foaming and priming. A heavy blowdown is then necessary, lowering the concentration to a point lower than necessary, "D." In contrast to this, the use of the continuous blowdown will result in the maintenance of uniform concentrations as indicated by "A" and "B" in Fig. 2. Therefore some saving in the amount of actual blowdown is possible by the use of a continuous blowdown rather than control by manual blowdown. There will be installations where continuous blowdown is not justified due to the relatively small amount of blowdown required or where the installation of a continuous blowdown would not prove economical or be

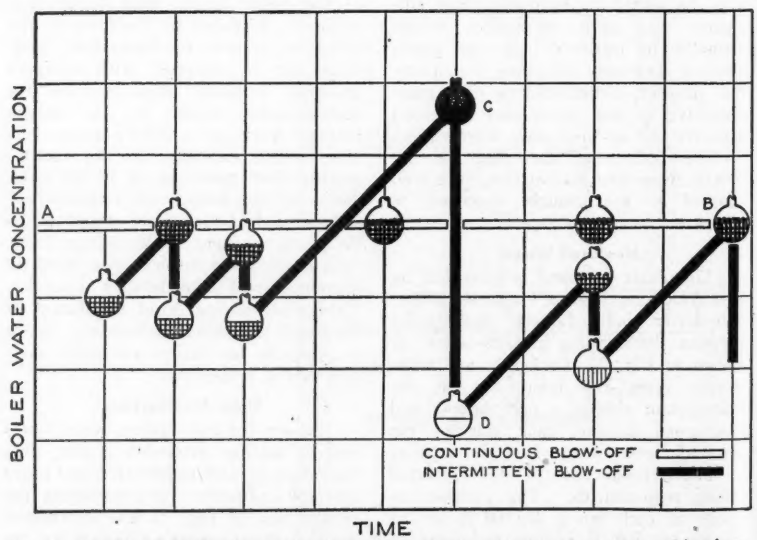


Fig. 2. Graphic chart showing contrasting effects of intermittent and continuous blowdown on boiler concentration

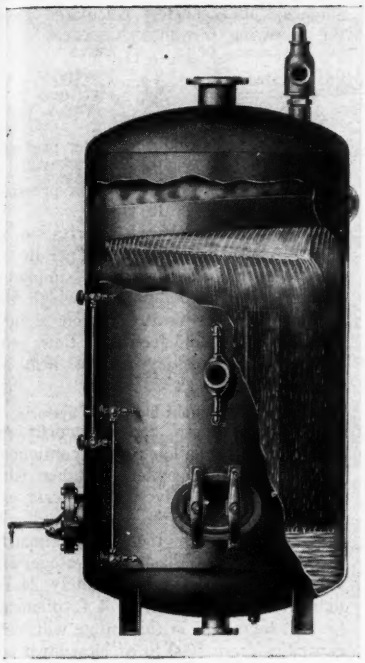


Fig. 3. Left—A typical tangential inlet design flash tank for a continuous blowdown system

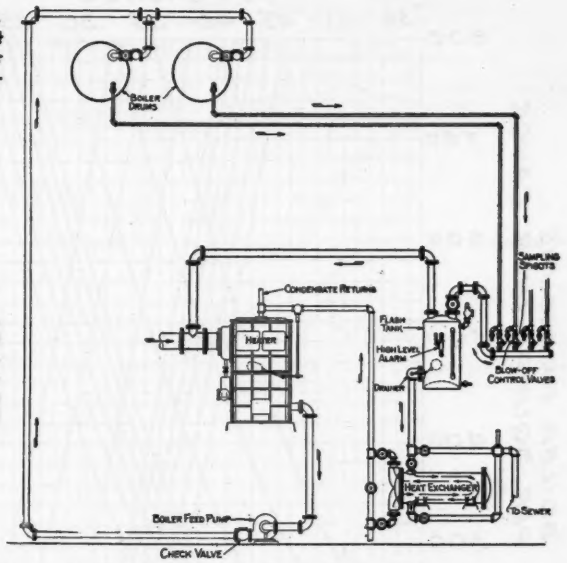


Fig. 4. Right—Diagram of equipment in a continuous blowdown system, showing how flash tank steam may be used in open heater

justified because of the cost involved. This must be individually determined by plant conditions.

How the Continuous Blowdown Process Operates

A continuous blowdown system consists essentially of a collection pipe located in the boiler at a point where concentration of the solids will normally be at a maximum and frequently in the steaming drum at a point somewhat below the water surface. From this collection line, the line passes through the boiler drum, and a first globe valve outside the boiler serves only as an emergency stop valve. At the point of control there is installed both a stop valve and a control valve. The control valve should be of the flow control type, preferably V-port, and marked for various settings indicating the degree of opening. It is with this valve that the rate of continuous blowdown is controlled. By setting this valve at the various markings, known quantities of water are removed from the boiler. The discharge from this line can be taken directly to waste if desired, in which case the cost of an installation is quite small indeed, probably not exceeding $100 per boiler.

Continuous Versus Manual Blowdown

One principal advantage, however, of continuous blowdown over manual blowdown is the fact that it is possible to recover most of the heat contained in the blowdown water, thereby improving overall efficiency of the plant. The first step in this heat recovery is to feed the continuous blowdown to a flash tank of the

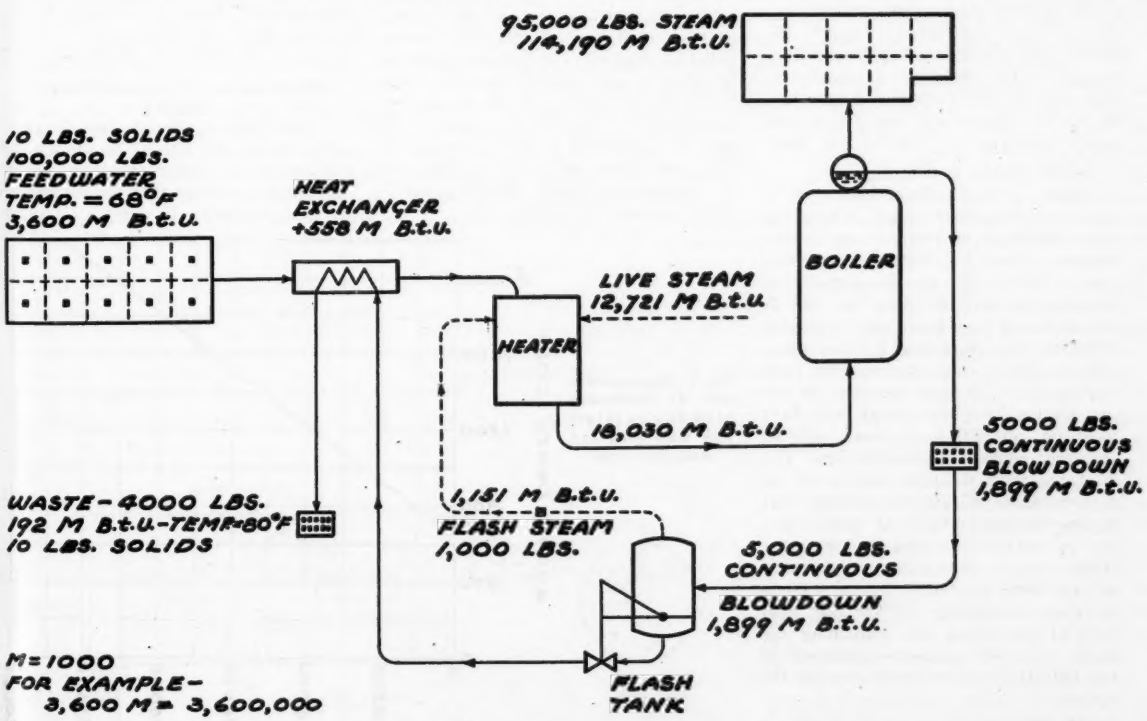


Fig. 5. Heat balance diagram of a continuous blowdown system similar to that of Fig. 4

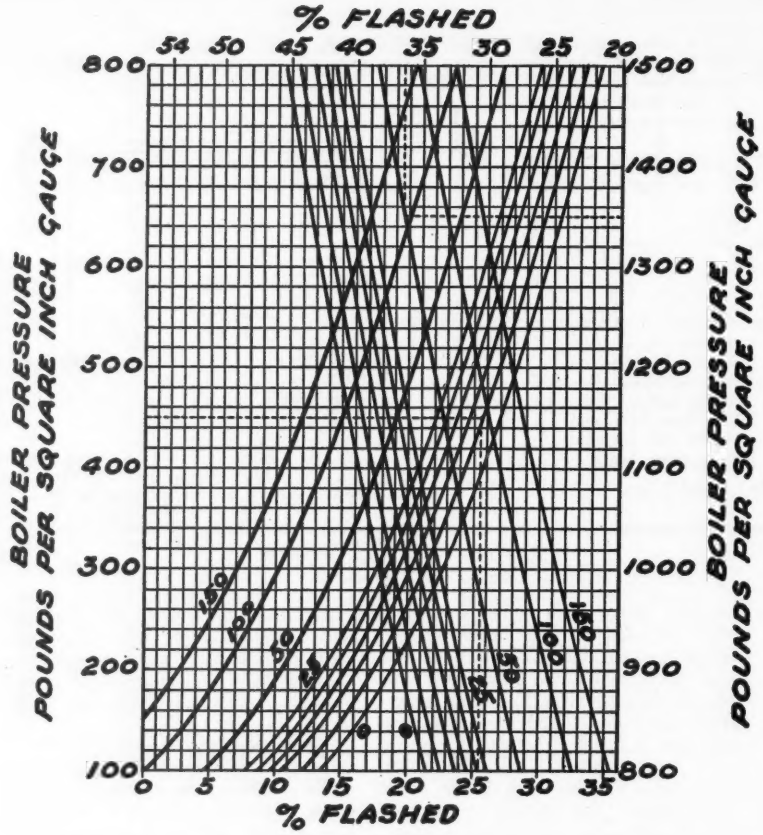


Fig. 6. Chart of flashed steam recoverable from continuous blowdown system

type shown in Fig. 3. As the boiler water is at a temperature corresponding to the boiling point at the boiler pressure, it will immediately "flash", the steam being liberated at the lower flash pressure. This steam can frequently be employed in the feedwater heater, reducing the amount of live steam that might otherwise be required for feedwater heating as in Fig. 4.

Figure 5 shows the elements of a continuous blowdown system, taking the same 100,000 lb of feedwater at a temperature of 68 F. There is a certain heat of the liquid at this temperature equivalent to 3,600,000 Btu. The 5000 lb of continuous blowdown water contains 1,899,000 Btu. Assuming a boiler operating at 250 psi, and assuming the flash tank with 2.5 lb back pressure, 20 per cent of the blowdown water will flash to steam, or 1000 lb of steam will be recovered containing 1,151,000 Btu. The discharge from the flash tank is still at a temperature of 219 F, and the heat in the remaining 4000 lb of waste water can be further recovered in a heat exchanger on the water going to the heater, so that there are finally wasted 4000 lb of water containing 192,000 Btu total heat of the liquid and containing the 10 lb of solids originally contained in the 100,000 lb of feedwater entering the system.

The flash tank is merely a closed pressure tank with an inlet for the blowdown water, a gage glass to indicate the liquid level in the tank, and a float control to maintain a water seal on the drain, a high level alarm, and a steam outlet connection. The flashed steam can be taken at any desired pressure lower than boiler pressure, and the amount of flashed steam that will be obtained will vary in accordance with the pressure of the boiler from which it is taken and the pressure at which flashed steam is recovered as shown in Fig. 6.

The amount of flashed steam obtainable can be accurately calculated from the following formula:

$$\text{Per cent flashed steam} = \frac{H_b - H_f}{V_f} \times 100$$

where

H_b = heat of liquid at boiler pressure in Btu per lb

H_f = heat of liquid at flash pressure in Btu per lb

V_f = latent heat of vaporization at flash pressure in Btu per lb

The heat exchanger is simply a counter-current flow unit in which the blowdown water flows through a tube bundle and the cold feedwater flows outside the tube, picking up the heat by heat exchange.

Cost of Continuous Blowdown Systems

The portion of the equipment required for installation of the continuous blowdown at the boiler, together with the flow control valve, is the least expensive portion of the system and will seldom cost more than approximately $100 per boiler. Flash tanks alone will vary in size from approximately 24 in. diameter by 4 ft high to 4 ft diameter by 7 ft high, and in this range will have capacities from 5000 lb of blowdown per hour to 20,000 lb of blowdown per hour. The cost of a continuous blowdown system with flash tank only will range from $400 for any capacity up to 5000 lb per hour of blowdown to approximately $750 for any capacity up to 20,000 lb per hr. The flash tank alone permits recovery of 50 to 75 per cent of the recoverable heat. The heat exchanger is the most expensive element of the system but its installation is frequently justified by the additional heat that can be saved. Approximate costs of complete system varying from 800 lb per hr to 20,000 lb per hr of blowdown are shown in Fig. 7.

Is Installation of Continuous Blowdown Justified?

Installation of the continuous blowdown system will depend on the possible advantages for boiler operation and on the possible savings that can be effected by heat recovery. If there is an excess

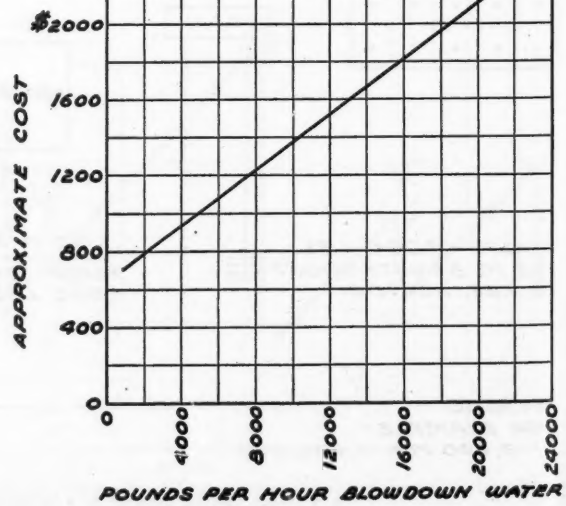


Fig. 7. Approximate cost of continuous blowdown system with flash tank and heat exchanger

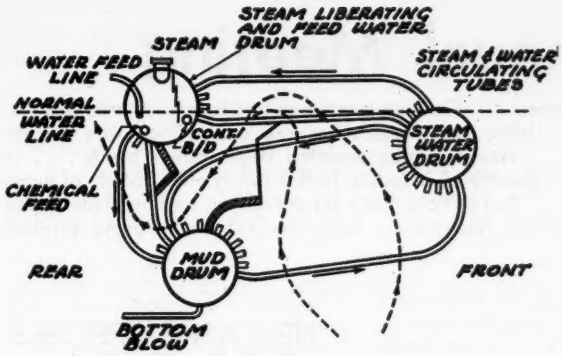


Fig. 8. How continuous blowdown system connection is installed on typical 3-drum, bent-tube, low-headroom boiler

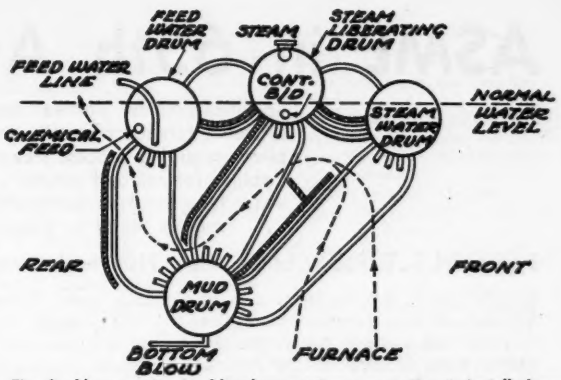


Fig. 9. How continuous blowdown system connection is installed on typical 4-drum bent-tube boiler

of exhaust steam from auxiliaries that is being wasted, over and above that necessary to heat all boiler feedwater, then obviously additional flashed steam would be of no value, and the installation of the continuous blowdown would only be considered from the advantage on boiler operation. If, on the other hand, all or part of this heat can be recovered, installation will usually be justified where blowdown amounts to 800 pounds per hr or over.

How Continuous Blowdown Is Installed

Figures 8, 9 and 10 illustrate typical methods of installing continuous blowdown systems in boilers. The shell of the boiler should be tapped and fitted by an approved method—one that will meet the requirements of a boiler insurance company. A pipe, the size of which is dependent on the required amount of blowdown, should be inserted through this opening and extend down inside the boiler to a point 2 in. to 4 in. below the low water level of the boiler. At this point, the collection pipe is attached. The collection pipe should be fitted with a number of holes, facing upward and the ends should be tapped and drilled. The total area of the holes drilled in the collection pipe should not exceed 75 per cent of the cross sectional area of the collection pipe to insure "orifice action" and collection along the entire length of the pipe.

How Continuous Blowdown Is Controlled

The rate of blowdown will be determined by operating conditions and a top limit for either total solids in the boiler or for certain forms of solids as may be indicated by the chemist or consultant advising on the control. On most low pressure boilers it is possible to maintain total solids up to 2500 ppm. Concentrameters of the electrolytic type are available (cost less than $50) for easy control of blowdown to indicate total solids concentration. Total concentrations can also frequently be determined by chloride tests with a knowledge of the ratio of chloride to the total solids. It is then only necessary to set the control valve at the point where the proper quantity of water will be removed to maintain the desired concentration.

What Maintenance Is Required?

The only maintenance that might be necessary on a continuous blowdown system will be the possible replacement of the V-port in the V-port valve every few years due to wear because of high velocity at this point, together with routine maintenance on packing this valve and the drain valve from the flash tank. If a heat exchanger is employed, and if the blowdown water is fairly high in suspended solids, it may become necessary to clean this heat exchanger once yearly. Any mal-functioning of the heat exchanger or indication that the unit is becoming dirty will reflect in increased temperature differentials between the waste water from the exchanger and the incoming feedwater. If the drain valve from the flash tank for any reason should stick closed, a high water alarm on the flash tank will sound to warn the operator to avoid carrying blowdown water into the flash steam line. If the level is properly maintained in the flash tank, no operating problem will be presented.

There are many plants in operation today where continuous blowdown should be installed in some form, either alone or with the flash tank heat exchanger, or complete with flash tank and the following tube heat exchanger where the installation would be quickly justified in a few months' operation. A brief study along the lines discussed will readily indicate the advisability of installation for the individual plant.

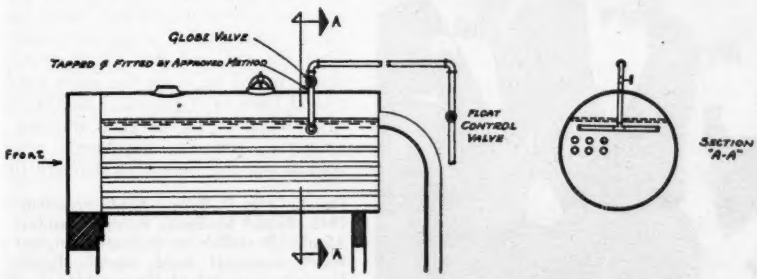


Fig. 10. How continuous blowdown system connection is installed on an hrt boiler

Power For Dunn Sulphite Paper Co.

(*Continued from Page 75*)

In addition to the alternating current used, direct current is needed for paper machine drives. This is supplied by a 300 kw synchronous motor, motor-generator set, located in the turbine room as shown in Fig. 2.

The main switchboard is metal clad with hinged panels and semi-flush instruments. A single transformer bank steps the voltage down from 4800 to 480 at which voltage most motors operate.

General Comments

On the whole, though of moderate capacity, this is a splendidly designed industrial plant. It makes use of every modern development in power plant technique and since it began operation it has fully proved its worth. Boiler efficiencies as high as 88 per cent have been obtained, and the plant has operated 6 days a week for several years with very little maintenance.

As shown by the photographs, it is light, clean and airy, all of which makes for good housekeeping. The building is of brick with large windows admitting a flood of daylight. The design lends itself well to the installation of a duplicate boiler and turbine whenever that becomes necessary with a minimum of additional investment. Since the power plant is an isolated structure, steam and power lines run across the yard to the mill buildings.

In conclusion, we extend thanks to Theodore W. Dunn, President of the Dunn Sulphite Paper Co. for permission to present this article and to Mr. Crist the plant engineer for his assistance in furnishing information and data used in its preparation. Credit is also extended to R. C. Roe of Burns and Roe, Inc., the consulting engineers.

ASME in 65th Annual Meeting

Specifications for postwar engineer . . . Colored moving picture technique broadens study of boiler furnace operation . . . Utility power executives see competition with industrial plants requiring process steam . . . Navy's railway mounted steam power plants . . . Gas turbines for railroad service . . . Quality of industrial fuels is falling off . . . Study of furnace water tube corrosion continuing . . . Suggestions made for preventing turbine blade deposits . . . Progress made in graphitization research . . . Some new instruments being developed

By RALPH E. TURNER, Editor, Power Plant Engineering

EVIDENCE that engineering is in a state of flux was never more plentiful than was brought out at the sixty-fifth Annual Meeting of the American Society of Mechanical Engineers which was held on November 27 to December 1 in the Hotel Pennsylvania in New York City and was attended by over 5000 persons. In every branch of mechanical engineering from research in fundamental principles to the management of men, new ideas flowed into the stream of thinking that will have lasting effects on the progress of industry in the years to come.

The objectives for engineers were well expressed by President Robert M. Gates in his paper "Engineers of Tomorrow," read by title only at the Annual Dinner, when he stated that engineering requirements of tomorrow involve five general assumptions: specialization without isolation, character as well as knowledge, acquaintance with the whole industrial process, adjustments in human relations, and extension of educational opportunity. He stressed particularly leadership in engineering education, and proposals for redirection and expansion of training and training for social responsibility, a feature which has been sadly neglected by the entire engineering profession.

"The changes we engineers have fostered," he said, "to create this fast-shifting world of new tools, gadgets, methods—to put to use the great forces of steam, electricity, chemistry—have been made against a background of a slower-changing human nature, ill adapted in its fundamental characteristics to such rapid change in its environment. These changes have value only in so far as they improve life of human beings. Our civilization can advance only as the adjustments in human relations keep pace with changes in our environment, or at least do not lag too far behind them. The heritage of freedom Americans enjoy, which has permitted our profession to make its finest achievements and which we depend on for future progress, cannot be taken for granted—else we shall lose it."

Power

One of the newer techniques in the study of furnace combustion is the use of colored moving pictures. These were first used to study the action of fuel beds during combustion and for this purpose the action of the bed is speeded up by taking exposures at intervals of seconds which makes possible the showing, in a few minutes, of the changing conditions taking place over hours. So helpful has been the use of these pictures in the study of stoker performance with various kinds of fuel that means have been developed for speeding up the taking of pictures and showing them in slow motion. By this means engineers are now in a position to study flame-propagation as it takes place in the gases over the fuel bed or in pulverized coal furnaces. This latter method has been helpful in the study of overfire air application, the effects of holes in the fuel beds, the flame pulsations caused by fan blades supplying overfire air and the variation in turbulence produced by change in nozzle location.

NEW ASME OFFICERS

President, Alex D. Bailey, Vice President of the Commonwealth Edison Company, Chicago.

Vice Presidents: David Larkin, Vice President and General Manager of the Broderick and Bascom Rope Co., St. Louis, Mo.; John E. Lovely, Vice President, Jones and Lamson Machine Co., Springfield, Vt.; and Thomas S. McEwan, Vice President, McClure, Hadden and Ortman, Inc., Chicago.

Managers: Daniel S. Ellis, Vice President in charge of manufacturing, Lima Locomotive Works, Inc., Lima, Ohio; Arthur J. Kerr, District Manager of sales, Pittsburgh Equitable Meter Co., Pittsburgh, Pa.; and Herman George Thielscher, Mechanical Engineer, Potomac Electric Power Company, Washington, D. C.

At one of the Power and Fuels Divisions sessions, this colored movie picture technique was demonstrated as applied to domestic underfeed stokers, multiple retort stokers, traveling grate stokers, and spreader stokers by T. S. Spicer, F. C. Ely and Otto de Lorenzi.

In a symposium on postwar power problems designed to promote general discussion of the problems and conditions surrounding the power producing field after the war, the leaders were E. B. Rickets, E. G. Bailey, P. W. Thompson, T. G. LeClair and F. M. Gibson all of whom spoke with optimism regarding the use of power.

The consensus of the discussion was that there was no great postwar power problem, that there would be no great sensational development that would completely revolutionize power development after the war, and that future developments would be along the same fundamental lines as at present. Mr. LeClair called attention to the great increase in industrial use of purchased power, pointed out that return to standard time

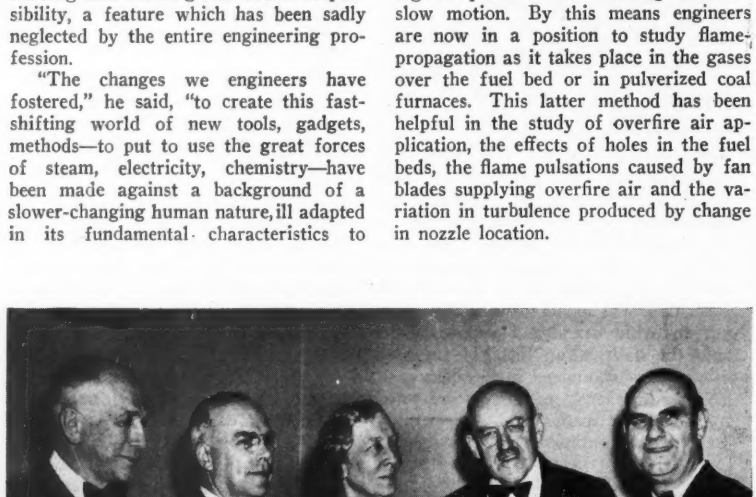


Fig. 1. Alex D. Bailey, ASME President for 1945. Robert M. Gates, retiring President of ASME. Dr. Lillian M. Gilbreth, recipient of Gantt Memorial Gold Medal. Ralph E. Flanders, recipient of Hoover Medal. William L. Batt, toastmaster at banquet

will add 1,000,000 kw to the demand without adding to kilowatt-hour output, stated that he expected steady increases because people will demand more and more electrical comforts. Mr. Rickets said a problem is to continue the downward trend of costs, with labor costs high, fuel costs higher than pre-war, lower than at present and more interest in prepared fuels. Changes will come gradually he thought.

Mr. Gibson showed that need for industrial power expansion is not great, that replacement is the important factor and that industrial plants as well as utilities will give more attention to multiple fuels and lower grade fuels. Mr. Thompson pointed out that much of the future work of the utilities will be in true betterments of equipment to improve public relations. Mr. Bailey agreed there were no startling developments with catchpenny names for the postwar period. He said there was need for improvements in smoke-making obsolete small industrial plants, heretofore badly neglected and equipment for these would be available and he felt something new was going to come into the small plant to improve it.

Further discussion brought out the opinions that industrial power inefficiency is less a matter of equipment and more of ignorance of engineers, since industry won't pay for good power engineering. Industrial power demands depend on process steam requirements. If utilities expect to beat that competition, they'll have to work out ways of supplying industrial steam as well as power. Industry usually considers its power plants a necessary evil; often the costs of steam and power are a small part of total costs. Also industry has to get its capital investment back in 1 to 5 years, hence is reluctant to spend money on power plants. Reliability and continuity of service are often more important than power dollar savings.

The gas turbine, it was felt, will come much faster as soon as it can burn solid fuels. The central station will not be the prime application of the gas turbine but in the stationary field, certain industrial plants have processes that will make it an attractive adjunct to them. The gas turbine is already here in transportation. Uses of portable plants, advantages of turbine standardization and influence of future taxes will also affect all future power developments.

Following the announcement a few months ago of development of mobile steam and packaged power plants for use in the devastated countries of Europe and Asia comes release at this meeting of the essential details of two 10,000 kw railway mounted mobile steam power plants recently completed for the U. S. Navy Department Bureau of Yards and Docks. These plants were described by Edwin Lundgren of the Navy and L. R. Biggs of General Electric Co.

These units are intended for the use of the Navy at coast stations wherever a breakdown in power supply or increased power demand occurs, where Navy work is involved. Each unit is a six-car power plant which includes a boiler car, turbine car, switch-gear car, transformer car, gondola car mounting auxiliary equipment, and a box car also containing pumps and miscellaneous equipment.

One Babcock and Wilcox natural-circulation boiler with a steam capacity of 120,000 lb per hr is provided for each unit. The operating steam conditions are 560 psi and 825 F total temperature. The furnace is completely water cooled and is designed for burning oil. The main power generating unit is a 10,000 kw, 14 stage, 3600 rpm turbine connected to a 12,500 kva 13,800 v 60 cycle General Electric Co. generator. The exhaust pressure at the outlet is 3-in. mercury abs, the vacuum being supplied by a Worthington surface condenser. One of the units has been moved to a southern city where it has been placed in operation to supply emergency service for a public utility plant supplying power to a naval activity. The other unit is also in service at one of the Navy's activities.

Discussion of the gas turbine was confined to its application to railroad locomotive use, the papers being presented by J. T. Rettaliata of Allis-Chalmers Mfg. Co. and Paul R. Sidler of Brown Boveri & Co., Ltd. Mr. Rettaliata described a 4800 hp electric-drive locomotive powered by two gas-turbine units each of 2400 hp for which he claimed a maximum efficiency of 16.8 per cent referred to the rail. Among the advantages given for this type of power are: the absence of water in the cycle, low maintenance cost, low lubrication costs, smokeless combustion and minimum vibration. Mr. Sidler stated that this type of locomotive has been accepted by the Swiss Federal Railways after a year of successful operation.

Fuels

Ignition through fuel beds on traveling or chain grate stokers has been under investigation at the U. S. Bureau of Mines laboratory in Pittsburgh for a long period and the findings to date were reported by E. P. Carman and W. T. Reid, their paper representing a preliminary outline of a bulletin soon to be made available by the Bureau. Various types of coals were studied under different arch arrangements, furnace temperatures and draft conditions. The findings resulting from this investigation will contribute to a better understanding of the use of traveling grate stokers in these times of changing fuels.

From statements made by leaders in a symposium on future trends in fuels, it is evident that industry will rely for a long time upon our natural resources of bituminous coal as the principal source of fuel. Oil and natural gas are the preferred fuels for many uses but they are rapidly becoming scarcer and more expensive. Possibly oil may be secured from foreign countries but world economy may prevent importation to the United States in the desired great quantities.

Synthetic motor fuels have been made and used in other countries and could be made here if price conditions warranted the building up of such industries.

All of our natural solid fuels are deteriorating in quality. The best grades of anthracite are securable only at premium prices and only the low grades are used in industry and modern domestic furnaces.

The higher grades of bituminous coal such as Pocahontus and New River are in such demand for metallurgical purposes that at present the supply for steam generation and heating plants has been shortened or delivery entirely refused by the fuel administration. This story is not new to the power plant field which is the leader in the use of low grade fuels, i.e., high ash, high volatile, high sulphur, low fusion and low heat value. The problem has always been one of developing furnaces and burning equipment that will handle the lowest grade and cheapest coal available at the plant. The equipment burning midwest coals and lignites are now being studied for their suitability for burning the lowest grades of eastern coals, for it seems evident that the high grades will gradually pass out of the market as a steam fuel.

Furnaces

Early in 1942, operators of slagging bottom furnaces became definitely aware of external corrosion of furnace wall tubes and investigations were started among operators and boiler manufacturers to determine the causes and devise remedies for the difficulty. A co-operative research program was undertaken

OPINIONS TO PONDER

LEARN how to anticipate the requirements of industry.

BY THE use or nonuse of gadgets, the public can encourage or discourage the development of ingenuity in the scientifically minded youths of the country.

CURIOSITY is the spur to ingenuity.

INVENTORS are the creators of frontiers.

ENGINEERS must learn to discard willingly a fairly successful device for an improvement.

NATIONS of the world would do well to increase their wealth through research and development rather than through robbery.

POSTWAR prosperity demands selling and distributing more goods—orders will not pour in.

PRODUCTION today is much more efficient than distribution.

NATIVE ingenuity is the nation's most powerful dynamo; but it usually operates far below capacity.

THE BURDEN of responsibility for postwar planning must be shared by all elements of the community.

INVENTIVE genius fully protected by a sound patent system is a paramount need in postwar America.

TO MAINTAIN our place in a warlike world we must keep our scientific and our engineering knowledge at a high level as a basis of national defense.

ACCIDENTS are faults to correct, not something inevitable in industry.

TOP MANAGEMENT has the job of producing greater quantities of quality products at low cost in less time by using materials, manpower and equipment now available.

HIRING the handicapped must be guided by respect for his abilities and not pity for his disabilities.

Charles M. Allen
Honorary
Membership

Earle Buckingham
Worcester Reed
Warner Medal

Edward G. Budd
ASME
Medal

Gano Dunn
Honorary
Membership

Emory S. Land
Honorary
Membership

Carl L. Norden
Holley
Medal

Fig. 2. Several recipients of awards; others honored were: Levin H. Campbell, Jr., Honorary Membership; Sir (Standen) Leonard Pearce, Honorary Membership; Ernest L. Robinson, Melville Medal; George W. Lewis, Spirit of St. Louis Medal; Martin Goland, Spirit of St. Louis Junior Award; Fred M. Piaskowski, Charles T. Main Award; Nelson B. Hammond, Undergraduate Student Award; Ralph E. Flanders, Hoover Award; Lillian M. Gilbreth and Frank B. Gilbreth (posthumously) Gantt Medal

by Combustion Engineering Co. and the U. S. Bureau of Mines at the latter's laboratory in Pittsburgh, supplemented by field investigations. The progress that has been made to date formed the subject of two papers by W. T. Reid, of the Bureau of Mines, B. J. Cross and R. C. Corey, the latter two being connected with Combustion Engineering. One of these papers dealt with the "History and Occurrence" and the other with the "Significance of Sulphate Deposits and Sulphur Trioxide in Corrosion Mechanism."

Investigation indicates that the "enamel" deposits found on the tubes in areas where external corrosion occurs are greenish-white to reddish-brown in color and are soluble in water, in which they produce an acid reaction. X-ray diffraction studies show them to consist primarily of a solid solution of sodium and potassium sulphates and alkali metal ferric trisulphates, such as $K_3Fe(SO_4)_3$. At temperatures of 1000 F, sodium and potassium sulphates will react readily with iron oxide in an atmosphere containing a low concentration of sulphur trioxide to form the same alkali metal trisulphates as occur in the "enamels." Under the same conditions of temperature and concentration of SO_3, however, neither iron oxide nor alkali metal sulphates alone will react with SO_3.

These reactions suggest the mechanism of corrosion involves the removal of the normally protective oxide on the furnace tubes by (a) the condensation on the relatively cool tubes of alkali metal oxides which are converted to the corresponding sulphates by the SO_3 in the furnace, and (b) the subsequent reaction of the iron oxide on the tubes and the alkali metal sulphates with the SO_3, evolved as the result of the slagging reactions in the coal ash deposited on the "enamel." Thus conditions are afforded for the removal of the iron oxide on the tube with the formation of alkali metal ferric trisulphates. Deslagging causes thermal decompositions of these compounds and the cycle is repeated.

One suggestion is that prevention of corrosion by this process may be achieved by ventilating the surface of the tubes with air so as to decrease the concentration of SO_3 below that necessary for the formation of the complex iron sulphates. Also, because the alkali metals required for the reaction are believed to originate principally from the flame, the addition of such air decreases the rate of deposition of alkalies. This is in agreement with field observations in which the maintenance of oxidizing conditions near the tubes by means of burner changes or air-belting prevented further corrosion. The role of such air is considered to be that of a diluent and the fact that carbon monoxide disappears in the process is not in itself important.

This investigation is being continued and findings will be reported in future papers.

Boiler Feedwater Studies

With the growing use of higher steam pressures has come the deposition of scale on turbine blades. At pressures of about 600 psi the deposits that form are water soluble and can readily be washed off. At pressures around 1400 psi, however, the type of deposit in the high pressure section of the turbine is water soluble but that in the low pressure section consists mainly of silica in its various crystalline forms that do not respond to water washing but are removable by mechanical cleaning or by washing with sodium hydroxide.

These problems have been investigated at the University of Illinois and the findings, to date, reported in a paper by F. G. Straub and H. A. Grabowski who have conducted the research in cooperation with the Utilities Research Commission of Chicago.

(*Continued on page* 128)

SELECTED PAPERS ON POWER TOPICS

Piping Arrangements for Acceptable Meter Accuracy. ***R. E. Sprenkle***

A New Device for the Solution of Transient Vibration Problems by the Method of Electrical-Mechanical Analogy. ***H. E. Criner, C. D. McCann*** **and** ***C. E. Warren***

Lubrication Characteristics of Involute Spur Gears. ***Ernest K. Gatcombe***

Some Thermal Effects in Oil Ring Journal Bearings. ***R. A. Baudry***

Stresses in a Cylindrical Shell Due to Nozzle or Pipe Connection. ***G. J. Schoessow*** **and** ***L. F. Kooistra***

Silica Deposition in Steam Turbines. ***F. G. Straub*** **and** ***Hilary A. Grabowski.***

Gas Turbine Road Locomotive for American Service. ***J. T. Rettaliata***

Gas Turbine Locomotive for Main Line Service. ***Paul R. Sidler***

High Temperature Gas Turbine Power Plants. ***John S. Haverstick*** **and** ***Arthur M. G. Moody***

10,000 kw Railway Mounted Mobile Steam Power Plants for the U. S. Navy Dept., Bur. of Yards and Docks. ***Edwin Lundgren*** **and** ***L. R. Biggs***

Optimum Compression Ratios for High Speed Diesel Engines. ***W. P. Green***

The Axial Vibration of Turbine Disks. ***Arthur M. G. Moody***

Heat Transfer from Baffled Finned Cylinders. ***A. W. Lemmon, Jr., A. P. Colburn,*** **and** ***H. B. Nottage***

Efficiency of Extended Surface. ***Karl A. Gardner***

Tube Spacing in Finned Tube Banks. ***S. L. Jameson***

Air Cooled Steam Condensers. ***R. A. Bowman***

Heat Transfer Through Tubes with Integral Spiral Fins. ***D. L. Katz, K. O. Beatty, Jr.,*** **and** ***A. S. Foust***

Heat Transfer and Pressure Loss in Small Commercial Shell and Finned Tube Heat Exchangers. ***R. M. Armstrong***

The Economics of Individual Serrated Finned Surface. ***E. A. Schryber***

Disk Extended Surfaces for High Heat Absorption Duty. ***G. E. Tate*** **and** ***John Cartinhour***

Heat Flux Pattern in Fin Tubes Under Radiation and Relative Efficiency of Fin Tubes in Convection Zone. ***A. R. Mumford*** **and** ***E. M. Powell***

Heat Transfer and Pressure Drop of Liquids in Double Pipe Fintube Exchangers. ***B. DeLorenzo*** **and** ***E. D. Anderson***

The Heat Pump—and All Electric Year-'Round Air Conditioning System. ***Philip Sporn*** **and** ***E. R. Ambrose***

Graphitization of Low Carbon Molybdenum Steels. ***Harold J. Kerr*** **and** ***J. Eberle***

Progress Report on Graphitization of Steam Lines. ***S. L. Hoyt*** **and** ***R. D. Williams***

Investigation of Graphitization at Detroit. ***R. M. Van Duzer, Jr., I. A. Rohrig,*** **and** ***Arthur McCutchan***

A Study of Austenitic Welding for Control of Graphitization. ***I. A. Rohrig***

Fundamental Consideration of the Problems of Graphitization of Carbon Molybdenum Pipe in High Temperature Steam Installations. ***G. A. Timmons***

Graphitization of Welded and of End-Quenched Carbon and Molybdenum Steels. ***G. V. Smith*** **and** ***S. H. Brambir***

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

SWEEPING REVENGE

On the west side of Chicago is a large plant devoted to the production of forging. At this plant, which has considerable floor area, there is a sweeper of dubious extraction whose function it is to keep the floors clean. His sweeping operations take up all of his time. Being a man who regards his profession seriously, he recently came to the conclusion that his services were worth more than what he was getting for his labors and so he struck the boss for an increase in stipend, emolument, or whatever it is that a sweeper receives for his work. As he tersely expressed it, "I needa da raise, Boss."

After due consideration by the management in which, no doubt, the probable profits of the company in post-war years were carefully weighed against the value of sweeper service, the request was acted upon, negatively, sad to say. Accustomed to hard knocks, he took his defeat stoically and went about his business, apparently, resigned to the economic forces working against him. Underneath his calm demeanor, however, he was concocting a devilish plan—he would get revenge. Had he been less of an individualist, he would have sought redress through the National Labor Relations Board, but not this guy, he could handle the situation himself. He got even in a diabolical way. He merely borrowed a saw from the carpenter shop, cut a short piece off each end of his broom, and went on sweeping. He still sweeps all day long but he doesn't sweep as much.

My guess is that he'll own the joint some day.

A.W.K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Keeping Cool in A Booby Hatch

By GEORGE HOLMAN

"I ain't no mechanic; and I ain't no mechanic's son.
I jist take a mechanic's place until a mechanic comes."

SEVERAL YEARS ago I got my first call to service a refrigeration system in—of all places—an insane asylum. Having dabbled in refrigeration for a number of years, I was probably overdue at the institution. Still, the call came as something of a surprise.

It seems that the institution master mechanic had once smelled ammonia on my breath, and thought of me in a pinch when the irregular service man failed to show up. The service man had always been dilatory about responding to calls, and always seemed in a hurry to get away, the master mechanic informed me. Pay was prompt and certain, and there was no apparent reason for the service man's conduct. At first I suspected that he did not greatly admire the skill with which three or four inmate butchers wielded their excellent knives and meat cleavers.

Problem 1. Reversed Compressor Rotation and Too Much Frost

A second man, whom I at first took to be an inmate, but who turned out to be the state-appointed chief, told me that the trouble lay in their sharp freezer (Room 5, Fig. 1). He said: "The lowest it will git is 26 or 7. When I first come here to work, it would go down to 15."

One glance into the freezer seemed to confirm the first suspicion to jump into my mind. The evaporator was encased in a solid mass of ice.

"Goodness, no!" the chief exclaimed, when I suggested an immediate defrost. "Maybe next week. But not today. We've got some stuff we've got to freeze right away. Can't you do somethin' to make it colder for a few days longer?"

The chief stood his ground, too, in spite of my arguments, explanations, etc. I became aware of a more pertinent reason why the service man was dodging the place. More out of personal interest than due to any desire to be helpful, I looked the storage over. It was a flooded system. By climbing upon a baffle-drain, I located a high pressure float regulator, the presence of which the master mechanic had at first denied. "I thought that thing was some kind of a gas trap," he eplained.

The float regulator controlled only the primary expansion. The evaporators were of 1¼-in. pipe. As shown in the sketch, they were installed in series. Actually, they were in series only when operating at capacity. Three-quarters-inch liquid lines by-passed each evaporator, excepting only that of the freezer. In each of these short lines there was a standard hand expansion valve (Valves E-1, E-2, E-3, E-4 and E-5) for secondary expansion. If any single evaporator was to be operated at capacity, the valve in the by-pass line had to be closed tightly, not opened.

Automatic control was by a lone adjustable thermostat at X, Room 4. As may readily be seen, all secondary expansion valves had to be adjusted to synchronize with temperature, load, etc., in Room 4. I found the pointer against the low temperature stop. The two evaporators were solidly frosted, and the room warm enough to keep the compressor running a year, if it could hold together that long. I found it (the compressor) in a none too neat room outside the building. It sounded like a one-legged man with crutch and hobnails doing the buck and wing on a manhole cover. Suction pressure was 30 psi, with enough gas blowby to merit a position in Washington.

I saw at once that the job was bigger than I had bargained for. "Your compressor is running backward," I told the master mechanic, and wiped off the dust to point out the rotation arrow on the shaft-end oil pump. If this compressor was splash-oiled, reversing rotation would have done no damage. But this pump is trying to pump oil away from the rings and bearings. You need new bearings, new pistons and new cylinder liners. Better call your service man at once. If he won't come, call the company that installed this outfit and have them send a man out."

Both the chief and master mechanic looked sore and disgusted as I walked out. They had called me to put their refrigeration system in working order. And all I had done was wipe off a bit of dust and tell them they had a big job and some expense on their hands. I did offer to change the compressor rotation. But they thought it was correct, and wouldn't let me.

Problem 2. Bad Leak

I thought that would be my last visit. But just 17 days later I got an emergency call. I arrived to find a bad leak at L, Fig. 1, where a long ¾-in. nipple screwed

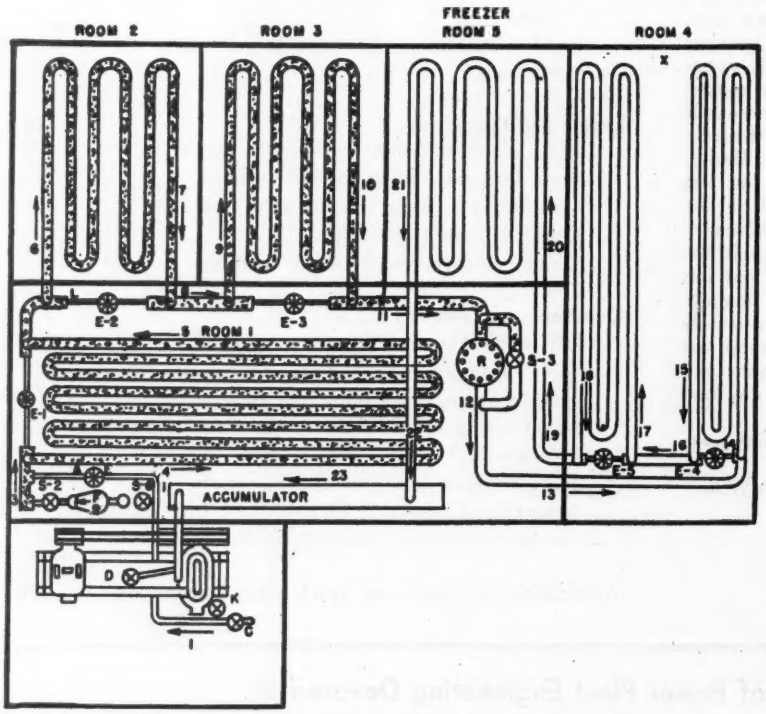


Fig. 1. General layout of dual pressure multiple cooler, flooded refrigeration system. Primary expansion at floating regulator F, with auxiliary expansion valve at A-E and secondary expansion at valves E-1, E-2, E-3, E-4 and E-5. Pressure regulator R divides the system into two parts. Pressure in evaporators of rooms 1, 2, and 3 (cross hatched) varies from 30-60 psi. Pressure in evaporators of rooms 4 and 5, set at 15 psi. When system operates at capacity, all refrigerant follows arrows in their numbered sequence

into a bushing-type reducer. With the system well-changed and the compressor operating, the chief and master mechanic, assisted by some other insane people, were attempting a general defrost—with very hot water. The threaded end of the nipple couldn't take it.

The blow was a bad one, with liquid spewing out. And what was worse, the master mechanic had not known enough about refrigeration to start a pumpdown. After some delay getting a couple of doors unlocked, I reached and closed the king valve K leading from the condenser. I was pleasantly surprised to find that the compressor had been thoroughly overhauled by an able mechanic, and the leads of the three-phase motor switched to rotate the machine correctly. The service man had made the repair, I learned. He had also insisted upon the defrost.

I lit two sulphur candles, and without a mask made a mad dash into the storage to set them where they would do the most good. I made a second trip into the storage, this time with a tub to set under the dripping ammonia. I put their hose end into the tub, switched to cold water and cleared out to a shady spot well out of range of the fog rolling out of the storage. I sat down on a packing box and announced that I was the best pinochle player in seventeen counties. If someone would produce a deck, I would prove it—three-handed preferred.

No one brought the cards. Several inmates looked perplexed. The master mechanic looked foolish. The chief got sore. "Ain't there somethin' you can do to stop that leak?" he demanded crossly. "Close some valves or somethin'?"

Close some valves or something! Look at that system carefully, 3,000 feet of 1¼-in. pipe loaded to the gills with liquid ammonia which had to be evaporated and pumped out with a 4 by 4-in. single-acting twin-cylinder compressor turning 340 rpm. The only part I could cut off was the liquid line between the king valve and the stop valve S-2. And that much wasn't worth a trip into the foul air of the storage to accomplish.

Before answering, I carefully recalled to mind as much of the system as I had seen on my previous visit. "Sure, I'll stop the leak," I assured the chief. "In about two hours. Ten minutes to fix the leak, and a hundred-ten to pump down before I can take that nipple out."

My guess was 30 min. shy on the pumpdown, and about the same on the nipple. The threaded end broke off inside the reducer, and I had to fish it out with a makeshift comealong.

Problem 3. Dual Pressure and By-Pass Expansion

Possibly six months elapsed before I got a third call to the asylum. The complaint was again that the freezer would not get cold enough, while rooms 1, 2 and 3 got too cold. The suction gage showed 30 psi, which wouldn't permit a very low temperature in the freezer.

Along with the master mechanic, I made a general check of the system. To my astonishment I found the secondary expansion valves E-1, E-2 and E-3 closed tightly. "I've got these rooms cut off completely," the master mechanic assured me. "But they got so cold these last few nights that they froze the fruit and smoked meat."

Rather undiplomatically, I called a halt in the inspection tour to go outside and laugh uproariously. A dozen inmates gathered about, cranking one another's ears and pointing to me. When they began to talk about a padded cell on Ward 4, I took the hint and went back to explain his mistake to the master mechanic.

Until I remembered the high suction pressure, capacity operation of the first three evaporators seemed to indicate a deficiency of refrigerant. It looked like all liquid was being evaporated before it reached the freezer. It was possible for the gage to be wrong. But—

In order to follow the line more closely, I climbed upon a locker and peered over the baffle-drain. There I located the diaphagm-motivated pressure reducing valve R—— with the stop valve S-3 in the by-pass line around it wide open. Until then I had assumed that the pressure indicated by the suction gage prevailed throughout the low pressure side of the system. It was really a dual pressure system, with suction pressure existing only in the evaporators of Rooms 4 and 5.

I closed the stop valve S-3, and adjudged the stem of the reducing valve until the suction gage indicated 15 psi. This, and partly opening the expansion valves E-1, E-2 and E-3, solved the problem of temperature control for that time.

Problem 4. The Sinking Float

At least a year passed before I got another call to the asylum. The trouble this time seemed simple. Each time the compressor started, the safety heads slammed, and frost formed heavily on the suction manifold. Someone had opened the auxiliary expansion valve A-E a full turn. There was a new chief and new master mechanic on the job. And no one could tell me why this valve had been opened. I closed it, reground the safety head seats, poppet type suction and discharge valves, etc. The remedy seemed too simple.

It was. Within a week I was back at the asylum. Freezer temperature had risen to 30 F. Suction pressure was 8 psi. To check on the pressure reducing valve I opened the stop valve S-3. Suction pressure remained unchanged. That meant that the float regulator was out of order, or that the system had lost its charge. A turn of the expansion valve A-E raised the suction pressure to 30 psi. It was the float.

After the pumpdown, I removed the regulator. The only thing I could find wrong was a badly eroded and corroded needle and seat. The equalizer tube was

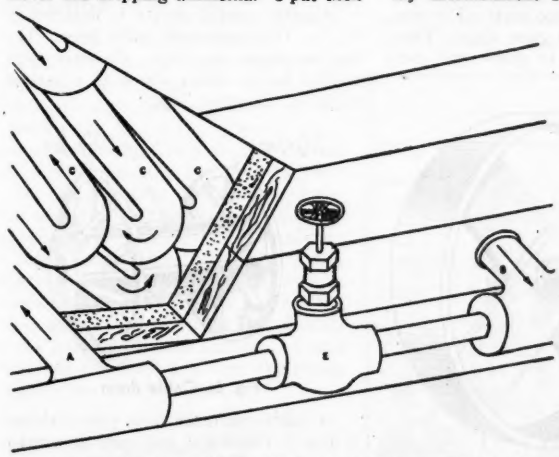


Fig. 2. Secondary expansion. Closing the expansion valve E forces all refrigerant to pass through the evaporator opposite it, and that evaporator operates at capacity. If this valve is opened wide, as much liquid as downstream evaporators can use is by-passed. In this case only the gas and a small amount of liquids will pass through the coils CCC from A to B

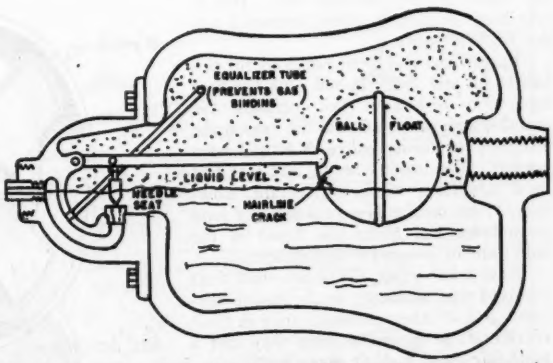


Fig. 3. The office of the high pressure float regulator is to keep the condenser free of liquid and the evaporators full, while keeping the condenser pressure out of the low pressure side during the off cycle. In problem 4 a hairline crack permitted the ball to fill with liquid and sink. Because the needle valve leaked, however, the regulator continued to admit some refrigerant to the evaporators

not clogged, as I had expected. I spun the needle in the chuck of a universal speed drill, and polished it smooth with a file. Ditto the seat, using a small file as a countersinking reamer. On replacing the needle, I adjusted it to compensate for the material filed off. I tested the ball float by submerging it in water while doing the other work. Then I made my first mistake by putting the regulator back into the line.

The system behaved nicely for three days. It began to warm up on the fourth day, I learned on the morning of the fifth when I was called again.

A 26-in. vacuum told me what was wrong. But how to prove it? I already had a pumpdown, but closed the valve S-2 as well as the king valve K. I got my wrenches in handy positions, then opened the auxiliary expansion valve A-E. Working as rapidly as possible in a highly uncomfortable position, and getting one slight liquid burn, I took the regulator out and dismantled it. As a reward for my speed, I had the satisfaction of seeing a thin line of white smoke stream away from a tiny crack in the ball as I tested it with a sulphur taper. There was enough liquid in the ball for frost to form. Not being under pressure, the crack had been too small to admit water on my previous test. But it was large enough to admit ammonia under high pressure.

Three days had been required for the ball to fill and sink. It had sunk the first time, too—had been full perhaps for months, and was doubtless the reason the auxiliary expansion valve A-E had been opened. The leaking needle and seat had been admitting some refrigerant, however. And on the first occasion my long pumpdown had given the liquid in the ball time to evaporate and escape.

New trim—especially a new ball float—solved that problem for the insane asylum. But if other problems arise in their refrigeration system, I hope they call a mechanic—*and I don't mean me!*

Interesting Welding Kinks

HERE ARE A NUMBER of rather interesting things useful around most every plant that can be made from material at hand by the use of the welding and cutting blowtorch.

In Fig. 1 is shown an adjustable pipe stand. This stand is a particularly handy piece of equipment for supporting the free end of a long length of pipe when

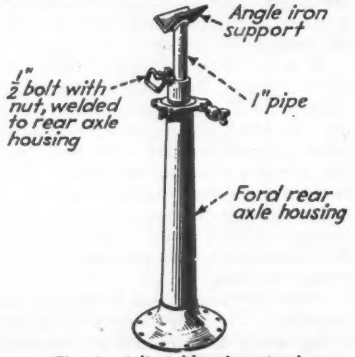


Fig. 1. Adjustable pipe stand

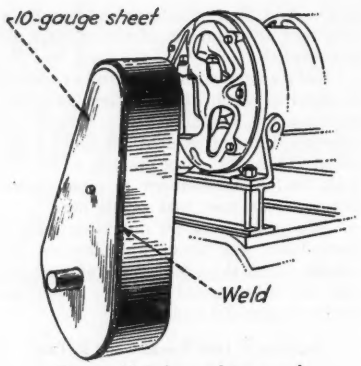


Fig. 2. Noiseless safety guard

the other end is held in a vise. The short length of angle iron is welded to a 1-in. pipe. Vertical adjustment is obtained by means of the setscrew which is made of a ½-in. bolt and nut.

Figure 2 shows how a noiseless safety guard can be fabricated out of sheet metal. The guard shown is for a belt drive but similar guards can be made for gears and other moving parts. The material used is No. 10 gage sheet. They are heated and bent to shape and then

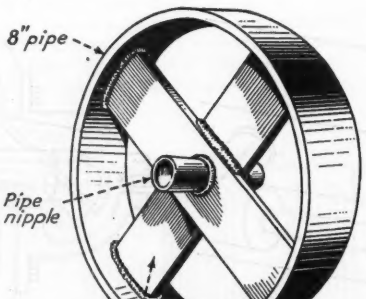


Fig. 3. Strong hand-truck wheel

welded with steel or bronze rod. Such guards can be made in half the time required for screwed guards and are strong, neat and free from noise and vibration.

In Fig. 3, we see a truck wheel. Such wheels can be made to replace broken cast iron wheels. The rim is 1½-in. wide and is hand-cut from a section of 8-in. diam pipe. The spokes consist of ¼-in. by 2-in. bar stock bronze-welded to the inside of the rim. The pipe nipple, which serves as a bearing, is bronze-welded to the spokes.

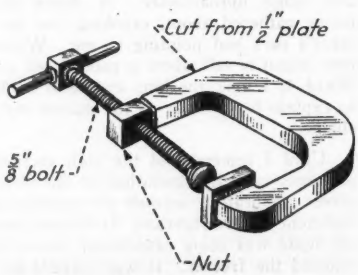


Fig. 4. C-clamp

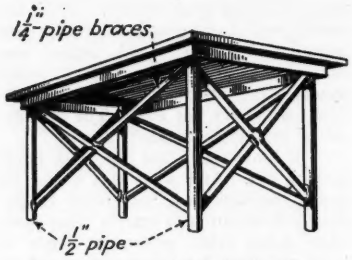


Fig. 5. Heavy-duty shop bench

A simple but easily constructed C-clamp is illustrated in Fig. 4. These C-clamps can be readily fabricated by hand-cutting a C-shaped section from ½-in. plate. The clamping device, shown in the sketch, consists of a standard ⅝-in. bolt with the nut welded to the plate. A short length of round bar stock welded to the bolt head serves as a handle.

Figure 5 shows a heavy-duty shop bench that will hold up to a 1000-lb load. The general dimensions are: length, 52 in.; width, 22 in.; and height, 24 in. The top can be cast iron or steel plate.

Another useful device is depicted in Fig. 6. This is a sturdy cable drum. The end members are 3-in. diameter pipe welded to the drum which is a section of 20-in. diameter pipe.

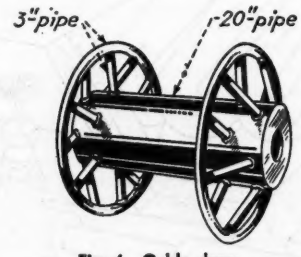


Fig. 6. Cable drum

A babbit pot made from pipe is shown in Fig. 7. Fabricated steel pots give twice the service of the usual cast iron pots which are apt to crack from repeated heating and cooling of the babbit metal. The steel pots are made by cutting and welding large-diameter pipe to form an orange-peel head. The base is made by cutting a section from a smaller-diameter pipe or by bending a piece of 1 in. bar stock to form a circle. The pot is hung by means of two loops made of ⅜-in. round bar stock, while a third loop aids in pouring operations.

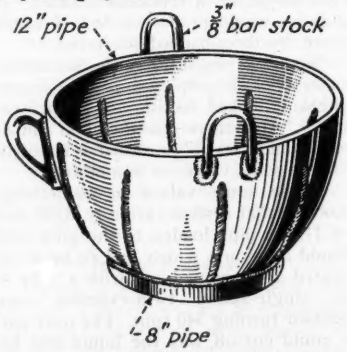


Fig. 7. Babbit pot from pipe

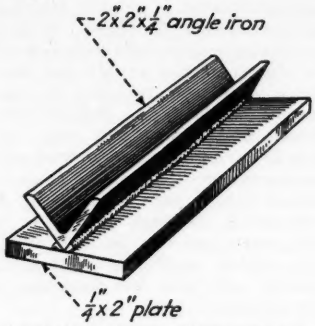


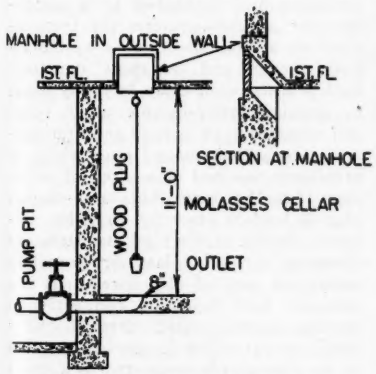
Fig. 8. Jib for holding rounds

Finally, in Fig. 8, we show a handy jig for holding rounds. These are convenient for use when welding drills, rounds, or even square bar stock. It consists of a piece of 2-in. by 2-in. by ¼-in. angle iron welded to a piece of ½-in. by 4-in. steel plate. The two pieces to be welded are aligned by placing them in the angle iron and butting the beveled ends together.

Foresight

By Dan Gutleben

FORESIGHT pays good dividends. The particular case described came from Dan Gutleben's famous "Log" at the Pennsylvania Sugar Co. Twenty years ago when the molasses storage cellars were built under the by-products plant at the Philadelphia Refinery, a manhole was provided in the wall directly above each of the 8-in. outlets as shown in the accompanying drawings. Some time ago, this manhole "cashed in." A muscular Polander with a bar on the valve handwheel, sheared the dowels off the parallel discs so that the wedges could not lift them and thus the pump suction line was blocked.



Details of manhole in molasses tank

There was four feet of molasses in the cellar. The shop made a wooden plug with a steel handle to plug the cellar outlet as shown. After this the bonnet was removed from the valve and new parts installed, requiring a half hour's time. Two days later the same "wreck"less Polander wrecked the No. 1 valve and the repair operation was repeated.

In anticipation of what might happen, the No. 3 valve was also fitted with the new parts to replace those that had lived through 20 yr. of abuse.

Without the manhole it would have been difficult to repair these valves without wasting a considerable quantity of molasses or incurring considerable effort in storing it temporarily.

All of the molasses tanks on the "farm" and the house tanks in general are provided with roof manholes directly above the outlets and duplicates in the shell near the bottom, opposite the outlets. This arrangement has on occasion proved its advantages.

Redeemables

By Atomizer John

Furnace Piping

FURNACE piping should be kept simple and since a straight line is the shortest distance between two points it should be engineered to eliminate all the ells, tees, dampers and valves possible. There's a pressure drop through any kind of fitting or bend regardless whether it is pulverized fuel, oil or gas. This in turn means the fuel will reach the burner at a lower pressure and this will have a direct effect on the burner characteristics.

Furnace piping should be of sufficient strength to allow a high factor of safety above operating conditions, and should be installed by using equivalent or higher strength fittings than the service requires.

Another much abused point is the failure to provide sufficient expansion. This in turn may result in piping failure.

Furnace Piping Valves

Even though a machined piece of metal may have the appearance of a valve, there are many times when a valve is not a valve, but just a piece of metal with a handle on it. The first requirement of a furnace piping valve is, it must be of size, strength, metal and type to meet all demands of the service it is in.

All valves should be workable and non-leaking, the only positive way to fulfill this requirement is routine running and graphiting of the valve stems and maintaining a very rigid schedule of inspection and maintenance of all valves. A weather-eye should be kept on combustion control, regulating, back pressure and burner valves, with periodic checks made on their operation because in case of a fuel failure they will be in top demand.

"I wish they'd kept him in the Army—I get sick and tired of him makin' us line up this way every morning."

The Boiler Fireman's Handbook

By J. R. DARNELL

Fighting spontaneous combustion of coal . . . Factors responsible for spontaneous combustion . . . Measurement of temperature . . . Effect of tempering coal . . . Clinker formation—causes and methods of prevention

VI. Coal Storage and Preparation for Use

BOILER FIREMEN, particularly in the smaller plants, often must supervise fuel storage and its preparation for use. Coal, of course, presents many more problems than oil while with gas there are practically none at all.

Fighting Spontaneous Combustion of Coal

A reserve supply of coal is both desirable and necessary in order to insure continuous operation of the power plant. Coal can be stored safely if certain well established rules are followed. Not all coals store equally well but experience has shown that conditions which cause spontaneous combustion depend more upon the size of the coal, freedom from dust and the manner in which it is piled rather than on the chemical composition of the coal. Clean, uniform size of screenings give the least amount of trouble in storage but mine run coal also can be stored if spread in layers so that the larger lumps do not separate from the finer particles. When this happens conditions may favor the infiltration of air through the larger particles on the outside to the fine material on the inside, resulting in spontaneous combustion.

Some operating engineers believe that when a fire starts in coal in storage, whether outdoors or in bunkers, the use of water is futile. Such opinion is not without justification. Of course, there have been occasions when fire in a coal pile was successfully extinguished with water, but in many cases it has caused a great deal of trouble.

If the coal is stored in a pit or bunker where the water cannot run off readily so that the burning coal can be submerged, naturally there will be no difficulty in extinguishing the fire. But where coal is stored out-of-doors in an open field the problem is often much more difficult. The author once was responsible for the fuel consumption in a large industrial plant where several thousand tons of Illinois and Indiana coal were in storage in an open field. When the rainy season started in the fall we had trouble with fires throughout the fall and winter.

Once we poured water on a fire with two streams from 4-in. fire hose for about 5 hours. At the end of this time the fire seemed to be out and we congratulated ourselves on having finally succeeded in overcoming the trouble, since many previous attempts had failed. But our jubilation was premature, for the next morning the pile was beginning to smoke again. After that we gave up attempts to use the fire hose and whenever a pile showed signs of heating we had the locomotive crane remove the heated portion and scatter it in an open space. In freezing weather, frozen coal is difficult to handle and does not spread satisfactorily on stokers. The disadvantages of wetting the coal to put out a fire greatly outweigh the few advantages.

As to the contributory factors in the spontaneous heating of stored coal authorities differ as to the probable effect of moisture, but observations have shown that if midwestern coals are put into storage piles during warm rainy weather the possibilities of spontaneous combustion are much greater than where the coal, if already dry, is stored during cool dry weather. Most authorities state that the sulphur content of coal contributes very little to spontaneous heating, but there should be further investigation of this problem since there is a possibility that the form in which the sulphur occurs in the coal may be either a positive or negative factor in spontaneous ignition.

For example sulphur in coal may be found as pyrite (metallic sulphur), as sulphate, or possibly in some organic combination such as various mercaptans, the simplest form of which is methyl sulphide. The presence of sulphides, either metallic or organic may cause more rapid oxidation than in coals where the sulphur is in the form of sulphates or in coal having little or no sulphur at all. But whether or not the presence of sulphur in some form is a contributory factor in spontaneous heating, it is significant that coals with high percentages of sulphur also have high percentages of oxygen. Most authorities agree that coals with high oxygen absorb oxygen readily and therefore have greater tendency to spontaneous combustion. Representative Illinois or Indiana coal may have 24 to 25 per cent oxygen as fired while Pocahontas or other eastern coals will average 6 to 7 per cent oxygen. Accompanying the high oxygen in the midwestern coal may be 3 to 3½ per cent sulphur while the eastern coal probably will have less than one per cent sulphur.

It is generally agreed that fine coal is more readily oxidized than coarse particles and therefore to avoid overheating and subsequent spontaneous ignition of the coal pile, care should be taken to prevent segregation of the particles. This can be done if the coal is spread as it is dropped and not allowed to form cone shaped piles. But it is extremely difficult to get the average crane operator to spread coal in uniform layers and refrain from "peaking" the pile.

Some engineers have recommended the use of ventilating pipes in large coal piles, but this scheme has been largely unsuccessful since it is almost impossible to ventilate uniformly the pile in such a way that there is sufficient cooling to keep all of the coal particles below the kindling temperature. It has been found by repeated measurements that if the coal temperature, generally found at 5 to 10 ft beneath the surface, reaches 135 to 140 F, this point should be kept under close observation and if the temperature rises rapidly above 170 F, the coal should be moved from this point, spread out and cooled or immediately burned.

By using an especially designed thermocouple, connected to a potentiometer or galvanometer the temperature of a coal pile can be systematically checked and "hot spots" detected. Such a thermocouple can be easily made by peening thermocouple wires (iron and constantan or copper and constantan) into a cone-shaped plug which is fitted into one end of a piece of ½-in. pipe, 12 to 15 ft long. This cone-shaped plug is held in place by an Allen setscrew. Inside of the pipe the wires are threaded through glass or porcelain tubing or one of the wires may be wrapped with tape and connected to binding posts bolted through fiber disks, one of which is screwed on to a ½ in. pipe nipple connected to a cross tee just back of this. This cross tee is provided in order that short pieces of pipe, 8 to 10 in. long may be screwed into the sides of the cross for use as

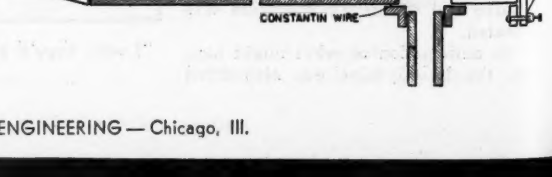


Fig. 1. Hot spots in coal piles can be detected with a thermocouple made from ½ in. pipe and fittings and provided with a cone-shaped point for easy penetration

handles. These handles facilitate the insertion and removal of the thermocouple at various points in the coal pile. Figure 1 shows a longitudinal cross section of this thermocouple.

Tempering Coal Increases Efficiency

Coal that has been properly tempered will burn completely with less excess air, with less clinker formation and with lower ash pit loss than coal that is too dry. This applies to the operation of all methods of fuel bed firing — hand firing, underfeed and overfeed stokers as well as traveling grate stokers.

Coal is properly tempered when its surface moisture content is increased from 2 to 5 per cent, uniformly throughout its entire mass. Since time is a necessary factor, tempering is best accomplished by adding water at the time the coal is put into storage or into the bunkers. Properly designed sprays above the conveyor not only add the water in small increments but the tumbling action of the coal from the conveyor belt or buckets into the bunker assures uniform distribution. Some concerns prefer to buy run of the mine coal and then do their own crushing and sizing. Adding the proper amount of water at the crusher insures uniform distribution. T. A. Marsh[1] says that the steam formed from the moisture in coal does not cause the particles to burst open but the formation of steam between the particles probably prevents the binding action of coal tars. This action of the steam keeps the fuel bed more porous, permits more uniform distribution of the air and because of its high specific heat undoubtedly helps to cool the ash below its fusion point, provided of course, that it is not disturbed and is allowed to settle to the grate surface.

Mr. Marsh says that considering 3 per cent as a fair average of the moisture required to temper coal properly, the heat loss to the chimney due to the added moisture is low. Even if 5 per cent moisture were added the loss would be not more than ½ of 1 per cent. The advantage derived from tempering are many times this figure.

Clinker Formation Depends on Temperature

One of the most serious complaints against low grade coals is the formation of clinker. To present proper approaches to this clinker problem we must first know what it is. Clinker is ash which has been fused and then solidified.

Although the sizing of coal is not the greatest single factor in the prevention of clinker yet its importance should not be neglected. The necessary amount of moisture for proper tempering cannot be uniformly distributed unless the coal is properly sized. In general, fine coal can be burned with better results than when it is too coarse but the uniformity of particles is the most important item in the sizing of coal. For natural draft chain grate stokers 1¼ in. screenings often are specified but the percentage of fines sometimes is so great that when the coal is discharged into the stoker hopper from the bunker the large particles roll to the outside and the fines settle in the middle. The larger particles allow more air to pass through and burn more rapidly. The rate of burning is so rapid that the ash is exposed to the radiant heat of the side walls and the arch. This intense heat fuses the ash and excessive clinker formation along the sides is inevitable. In some coals the fusion point of the ash is as low as 1800 to 1900 F, while in others it may be as high as 3000 F.

In most cases, the coals of the middlewest have ash with lower fusion points than eastern bituminous coals and the most attention has been and still is being given to the clinker problem in the middlewest. Since, normally, operators of industrial stokers in this section cannot justify the purchase of eastern coals when burning local coals with high furnace temperatures, they find it necessary to keep the ash out of the zone of high temperature to avoid clinker formation.

This avoidance of clinker formation by keeping the ash below the fusion point may be accomplished in several ways, depending upon the type of grate or stoker used. Probably the best type of stoker for coals with high percentage of ash which usually have low fusion point, is the chain or traveling grate. Such a stoker may be either of the natural or forced draft type. If forced draft is used, however, the combustion rate (pounds of coal burned per square foot of grate area) must not be pushed very much beyond that obtained with natural draft in cases where the ash has a very low fusion point. The percentage of ash and its fusion point determines the optimum combustion rate and there are no arbitrary rules which may be applied.

A minimum disturbance of the fuel bed is absolutely necessary when burning coals which have a tendency to form clinker. If the ash is brought to the top of the fuel bed where the temperature is higher than at the grate surface it is only natural that clinker will form if the fusion temperature of the ash is equal to or lower than the temperature at the top of the fuel bed. Some coals have a tendency to coke or to puff up into "cauliflower" shapes. Combustion is retarded at these points and firemen often use a slice bar or hoe to break up such formation. This causes a disturbance of the ash and clinkering usually results.

Almost every boiler fireman probably has noticed that when refuse such as newspapers, magazines, books, wood scraps, rags or perhaps garbage, is thrown on the fuel bed, clinkering to a much greater extent will occur than when coal alone is burned. In a paper read at the Second International Conference On Bituminous Coals held at the Carnegie Institute of Technology in Pittsburgh in 1928, Langtry[2] and Kohout gave the results of tests made on the fusion temperature of samples of coal ash, garbage ash and mixtures of the two kinds of ash. It was found that the fusing temperature of the mixture was lower than that of either of the constituents. In one example the fusion temperature of the coal ash was 2678 F and that of the garbage ash was even higher, being 2862 F. But the fusion temperature of the mixture was only 2294 F. In another case the coal ash fused at 2539 F, the garbage ash at 2862 F, and the mixture at 2185 F. All tests were made with mixtures of 90 per cent coal ash and 10 per cent garbage ash. The authors state:

"It would be reasonable to assume that if even a smaller percentage of garbage ash were mixed with coal, the fusion temperature might even be lowered to a greater extent."

Overfire Air

THE NEED of supplying enough air for complete combustion of any fuel is so elementary that it requires no argument, but just how that air shall be introduced and mixed with the fuel is still one of the livest and most important problems of combustion engineering. It has within it the possibilities of preventing smoke, of increasing boiler efficiency, of lightening the labor of the fireman, and of cutting costs.

The Bureau of Mines has determined that only about 7 lb of air per lb of carbon can be passed through a uniform bed of incandescent coke. Yet it requires 11½ lb to effect complete combustion. The rest has to enter the furnace through holes in the fire, at the back end of a chain grate stoker, through open doors in a hand fired furnace, or in other improper ways; OR, it may be scientifically introduced over the fire through nozzles suitably placed to provide proper distribution. This overfire air is made to enter the furnace at considerable velocity, so that not only the required weight may be supplied, but that greater turbulence and mixing with the furnace gases will result.

This air may be moved by the well-known motor driven fan or by steam jets. Mr. R. B. Engdahl, Battelle Memorial Institute, Columbus, Ohio, has written a comprehensive report on the design of steam jets for overfire air introduction. Every engineer and plant manager should read it. There are also engineering organizations which make a business of designing and supplying this apparatus. Fan manufacturers also are conversant with this problem. Consult one of these.

Many times there is plenty of air in the furnace, but it is all bunched in one spot. This is called stratification of gases, and all that is needed is to mix them all up, and smokelessness will result. "Turbulence" is the answer. The overfire air jet will give this. Install at least two jets, and use them as necessary. You will be pleased with the result.

[1] T. A. Marsh—Combustion In The Power Plant—(Combustion Publishing Corp.—1924).
[2] W. D. Langtry and J. F. Kohout—Fusing Point of Ash From Mixtures of Coal and Foreign Materials.

How Would You Do It?

Problem 37. The Strange Case of the Capacitor-Motor

IF THE SCARCITY of solutions to a contest problem is any criterion of its difficulty or complexity, Problem 37 involving the case of the capacitor-motor must have been a "honey." Altogether less than a dozen solutions were submitted.

As we pointed out in the statement of the problem in the November issue, the problem could only be solved by making tests of equipment itself and in presenting it in this section we hoped, at best, only to get a clue as to what might be the trouble. This aim, we feel, has been attained and it will be interesting to know if the suggestions made in the letters presented here ultimately lead to a satisfactory solution of the trouble.

Our own opinion that the trouble was due to resonance phenomena was substantiated by the opinions of a number of the contestants which included the prize winners. It is possible, of course, that it may be due to simple little things which everybody has overlooked but from the facts which are available the most likely explanation is that at low loads the frequency or the harmonic content of the voltage wave is such as to establish a resonant condition in the tuned circuit formed by the motor winding and the capacitor and thus, cause it to draw increased current regardless of the actual mechanical load on the motor. Just why such a condition should suddenly arise after years of satisfactory operation is not easily answered but as is pointed out by Mr. Coscia who received the First Prize Award, it might be due to wear or lack of maintenance of the governors on the older engines thus permitting a slight variation in frequency to occur at light loads.

Unfortunately, one of the best of all the solutions received, arrived too late to be eligible for the contest. This was that submitted by Roland Berti, who won the first prize for his solution to Problem 36. Quoting from his letter which was received after the awards had been made, "After hitting the bell in your last issue on Problem 36, I didn't dare hope to do a repeat, so thought I'd lay low on this one. But this problem has intrigued me so much I could not resist putting down my views on it." Mr. Berti's generous attitude is appreciated but we wish to point out here that the fact that a contestant may have won a prize on one problem does not affect his chances in another contest, even the next one. The awards are made purely on the basis of merit and what one may have done on a previous contest has no bearing on his chances in following contests. Needless to say, we are glad to be able to present Mr. Berti's letter in full.

The first prize went to Lewis G. Coscia, mechanical engineer of Baltimore, Maryland. C. O. vonDannenberg, a frequent contributor in this section was awarded second prize for his thorough consideration of all possible factors in the problem. A. R. Markland was awarded third prize.

The prize winning letters follow:

FIRST PRIZE AWARD

Lewis G. Coscia
Baltimore, Maryland

The problem as presented is incomplete and many factors, which might bear upon the solution, are not given. By making several assumptions, however, a solution of the problem is submitted.

The problem states that the generating plant, consisting of 6 Diesel driven units has an installed capacity of 5000 kw. It further states that the largest generating unit is 3000 hp which is equivalent to about 2000 kw. The five small machines, therefore, have an average capacity of approximately 600 kw each. Although the speed of the compressor has been checked and found to remain constant, it is assumed that the check was made during the period of normal operation and that a small increase or decrease in the speed of the unit as it left the circuit was unnoticed.

A study of the graphs reveal that the base load on the generating station was inductive and that as the load dropped off the power factor of the system also dropped. The graphs also show that the motor in question stops whenever the power factor is low, and in general, whenever only two generating units are in operation in the power plant.

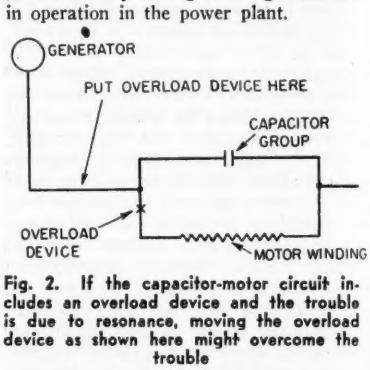


Fig. 2. If the capacitor-motor circuit includes an overload device and the trouble is due to resonance, moving the overload device as shown here might overcome the trouble

The final assumption is based on the small machines which are running in the power plant when the load is light. As these units are small and have been in operation over a long period of years it will be assumed that the governing mechanism is not reliable. This governing mechanism will allow the machines to slow down or to speed up on light load and thus decrease or increase the frequency of the system.

The ohmic equivalent of the inductive reactance of an alternating current circuit is

$$X_1 = 2\pi f L \qquad (1)$$

where X_1 is the ohmic equivalent of inductance

f is the frequency of the system

L is the inductance in henrys.

The ohmic equivalent of the capacity reactance of an alternating current circuit is

$$X_c = \frac{1}{2\pi f C} \qquad (2)$$

where X_c is the ohmic equivalent of capacity

f is the frequency of the system

C is the capacity in farads.

When the inductive reactance and the capacity reactance of an alternating current circuit become equal resonance occurs and the circuit acts as though it contained nothing but resistance. The following equation, which is true when resonance occurs in a circuit is obtained by equating equations (1) and (2).

$$2\pi f L = \frac{1}{2\pi f C} \qquad (3)$$

When such a condition occurs in an alternating current circuit the voltage across the inductive reactance and the voltage across the capacity reactance are equal and opposite, and the voltage in

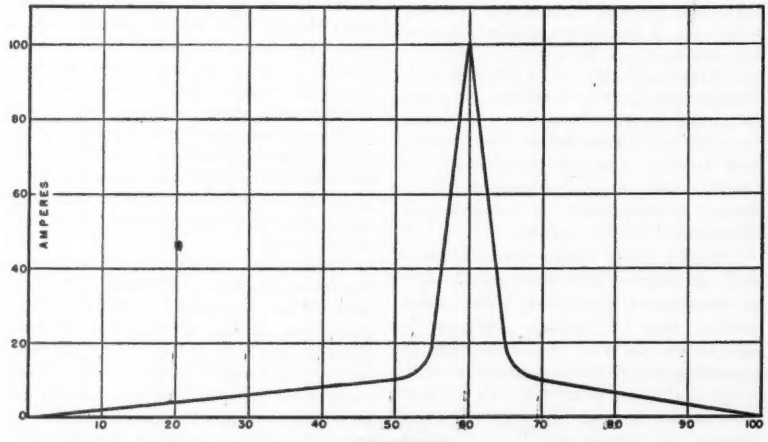


Fig. 1. Graph showing the variation of current with frequency in a resonant circuit

the circuit may be many times greater than the system voltage.

By solving equation (3) for f the natural or critical frequency of the circuit may be obtained.

$$f = \frac{1}{2\pi\sqrt{LC}} \qquad (4)$$

This is the frequency at which the circuit will oscillate unless acted upon by some external frequency. Resonant conditions of this type should be avoided in power circuits as the piling up of voltages may endanger apparatus and insulation and will cause large amperage to flow through the circuit.

The graph in Fig. 1 shows the variation in current caused by increasing the frequency in a circuit having both inductive and capacity reactance. The curve illustrates the natural or critical frequency which produces the maximum current.

Whenever the load upon the generating station in Problem No. 37 becomes light the frequency control is inadequate to maintain the desired 60 cycles. The frequency may either increase or decrease. As the capacitor-motor circuit has both inductive load and capacity load the variation of the frequency is sufficient to cause the frequency to approach the critical frequency of the capacitor-motor circuit with the corresponding increase in

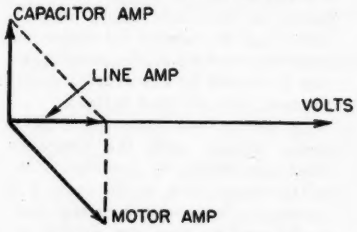


Fig. 3. Relation between capacitor current, line current and motor current

the voltage and amperage. This increase in amperage causes the motor to trip off the circuit.

The resonant condition has not shown up until recently, probably, because the governing devices on the Diesel driven generators have been maintained in good working condition and have held the frequency within a narrow limit. Recently, however, due to wear, lack of maintenance, or some other cause which can only be found by examination, the governors have allowed the frequency to vary on light loads and thus setting up a resonant condition in the motor circuit in the ice manufacturing plant.

To prevent the reoccurrence of the resonant condition the governing devices on the Diesel driven generators should be checked and repaired so that the frequency of the system can be held within narrow limits when the load is light.

SECOND PRIZE AWARD

C. O. vonDannenberg
Brooklyn, N. Y.

The problem is involved and apparently the general electrical details and mechanical features have been investigated. The connections, that is, the group arrangement of capacitors associated with the motor is not given so it is assumed that they are star connected as a group of three. This is merely a conjecture.

The load curves indicate trouble when the station load falls below 1200 kw or approximately that value. The fact that satisfactory operation was experienced for some 12 yr might indicate a change in some feature of the equipment and the most logical procedure would be, first of all, to be assured that there is no fault in the capacitors, either in the whole group or in individual units. The manufacturers of the capacitor can readily suggest tests.

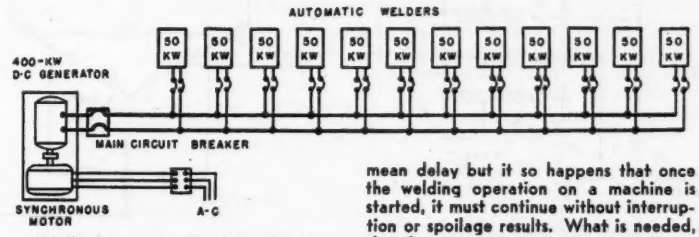
It is said that a "highbrow" is one who sees everything but the obvious. It may be so in this case. The trouble may be due to some very simple thing that everybody has overlooked.

It might be worth while to examine the wave shapes of the generator voltages of the individual generators, particularly those units operating in parallel when the load drops below 1200 kw. The fact that the capacitor current equals $EwC \times 10^{-6}$, where $w = 2\pi \times 60$ or 377; C is the capacity in microfarads and E, the voltage applied to the capacitor terminals. The capacitor current is responsive to the frequency or to the value of "w." The generator voltage wave may vary with the load and as a rule will show more pronounced harmonics when operating at lower loads. As the generator load increases, the electromotive force wave usually becomes smoother in shape, in other words, the effect of harmonics is less pronounced.

It might be desirable, therefore, to have voltage oscillograms taken of all the units for varying loads and particularly for the loads at which the trouble occurs. It may be possible to rent a harmonic analyzer from a local laboratory and also, help could be obtained from one of the engineering colleges. Naturally, the matter of expense has to be taken into consideration. There should also be available, the kilowatt input to the capacitor motor.

With information available based on tests such as just suggested it should be possible to determine at once whether at any part of the station loading, some harmonic is more pronounced than at other loads. Such pronounced harmonics might have a direct bearing on the current drawn by the capacitor motor. First, however, the condition of the capacitor should be determined by testing it at

Problem 38. Staggering the Operation of Electric Welders



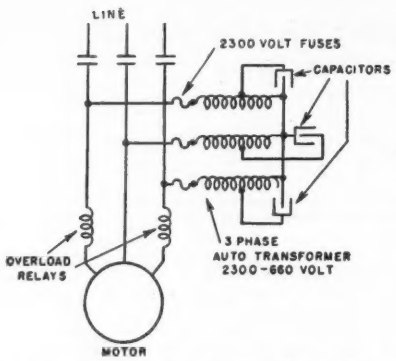
We had not seen Our Hero for some time and had been hoping that General Hershey had finally caught up with him and put him in the Army, but that was asking too much—he breezed in the other day and, as usual, with a problem. He is now working in a plant where they do a lot of electric welding. As he explained the situation it looks something like that shown in the accompanying diagram. A group of 12 automatic d-c welding machines are fed from a 400-kw motor-generator set as shown. Each welder takes 50 kw so if all 12 of the machines were used at once, the total load would exceed the rated capacity of the generator by 200 kw or 50 per cent. Originally, there were only 8 welders but during the last few years 4 have been added.

Because of the peculiar nature of the operations in the plant, it is not often that more than 8 of the machines are on the line at once. When in use, the welders are on about 2 minutes after which they will be off 4 or 5 minutes. Because of the difference in speed of the operators it frequently happens that more than 8 units are on the line at once, in fact, it is possible that all 12 may come on at one time and then there is trouble, the main circuit breaker usually goes out. In itself this would only mean delay but it so happens that once the welding operation on a machine is started, it must continue without interruption or spoilage results. What is needed, therefore, is some system, automatic or otherwise which will prevent any particular machine from being thrown on the line when the generator is supplying its rated capacity. If such a system were automatic, the incoming welder would merely wait a half minute or a minute—two minutes at most, until one of the welders was cut off and then the incoming machine would be cut in.

Well, there is the problem. How would you solve it? As shown, each welder is now fitted with its individual circuit breaker equipped with an overload trip. The machines are all installed in the same room which is about 200 ft long, the machines being placed in a single row. You cannot do the one obvious thing—you cannot get a larger generator.

Write out your solution to this problem in a letter of not more than 1000 words, illustrating it with diagrams if necessary. We will award a $25.00 War Bond for the best letter, and prizes of $10.00 and $5.00 respectively for the second and third best letters.

Entries for this contest should reach us not later than January 31, and should be marked Problem 38. Address all letters to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago 4, Illinois.



F. 4. A. R. Markland's suggestion for installing a separate set of fuses to protect the capacitor

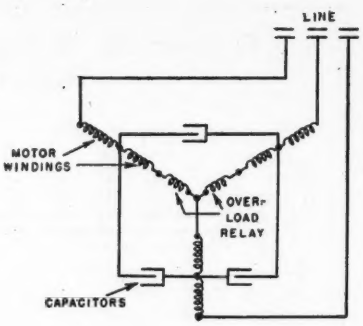


Fig. 5. The relay could be connected between two of the phase windings and the neutral

some voltage close to the rated voltage and at the 60 cycle frequency. If the current does not check with the nameplate rating then it will be evident that some harmonic condition exists or the capacitor is at fault. It is even worth while to try out another capacitor which the manufacturer would provide at minimum expense, and make another test under similar conditions. This would at least indicate whether the present capacitor was functioning correctly or not.

These are rather vague generalizations but they indicate how the writer would go about finding a solution to the problem. It would seem that the manufacturers of the motor should be able to contribute considerable help in solving this problem.

Condensers built in past years were far from immune from cumulative troubles. Hot spots quite frequently caused breakdown of the dielectric and this resulted in unbalancing. However, since the condition with which this problem is involved is only associated with a change of load it is not very likely that condenser breakdown is a factor.

One final thought: if the capacitor and motor are connected as shown in Fig. 2 it might be possible at some generator excitation to have a voltage applied to the motor such that at certain magnetizations would lead to resonance or partial resonance. This would cause a high local current to flow in the motor-capacitor circuit, assuming that the hook-up is as shown in Fig. 2. This would be merely a case of current resonance; the line amperes would not increase, in fact they might fall as shown in Fig. 3.

If this were the case, its indication, now, after 12 yr of satisfactory operation is difficult to explain. Poor voltage regulation might start it if the load changes are large enough. Putting the overcurrent device in the line outside of the local motor-capacitor circuit would obviate tripping. The use of a resistor in the circuit would prevent resonance or a shunting reactor could be used but in any case, before these are installed, careful tests of all conditions should be made.

THIRD PRIZE AWARD

A. R. Markland
Altoona, Pa.

The data supplied for this problem is incomplete as the induction motor is rated 2300 v while the attached capacitor is rated at 660 v. Is a step-down transformer interposed between the motor and the capacitor, is the motor Y wound and tapped at ½ the winding to feed the capacitor or is the latter being operated at three times its rated voltage?

Assuming that the capacitor is arranged to operate at rated voltage and is connected to the motor leads while the overload relay is connected in the line feeding the motor, then any increase in the current drawn by the capacitor would cause an increase in the current through

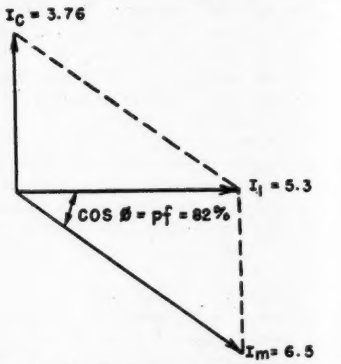


Fig. 6. Simplified vector diagram of the currents in the motor under normal operating conditions as presented by Roland Berti

the overload relays although the current drawn by the motor proper would not be raised. This increase in capacitor current is probably due to the presence of harmonics in the power supply wave form which may be damped out under normal conditions of load at the power plant or may be caused by a particular generator operated when the load is light.

As the current drawn by a capacitor varies directly with the frequency, a small percentage of harmonics in the voltage wave form would cause a large increase in the capacitor current and this would tend to raise the voltage at the capacitor terminals, thus further increasing the current.

In order to actually locate the cause of the trouble, measurements of the voltage and current to the capacitor should be made independently of the current to the motor proper under normal condi-

General Effect of Voltage and Frequency Variation on Induction-motor Characteristics

Variation		Starting and maximum running torque	Synchronous speed	% slip	Full-load speed	Efficiency			Power factor			Full-load current	Starting current	Temperature rise at full load	Maximum overload capacity	Magnetic noise at no-load in particular
						Full load	½ load	¼ load	Full load	½ load	¼ load					
Voltage	120% voltage	Increase 44%	No change	Decrease 30%	Increase 1.5%	Small increase	Decrease ½ to 2 points	Decrease 7 to 20 points	Decrease 5 to 15 points	Decrease 10 to 30 points	Decrease 15 to 40 points	Decrease 11%	Increase 25%	Decrease 5 to 6 C	Increase 44%	Noticeable increase
	110% voltage	Increase 21%	No change	Decrease 17%	Increase 1%	Increase ½ to 1 point	Practically no change	Decrease 1 to 2 points	Decrease 3 points	Decrease 4 points	Decrease 5 to 6 points	Decrease 7%	Increase 10 to 12%	Decrease 3 to 4 C	Increase 21%	Increase slightly
	Function of voltage	(Voltage)²	Constant	$\frac{1}{(\text{Voltage})^2}$	(Syn-speed slip)	.....	.....	.....	.....	.....	.....	.....	Voltage	.....	(Voltage)²	
	90% voltage	Decrease 19%	No change	Increase 23%	Decrease 1¼%	Decrease 2 points	Practically no change	Increase 1 to 2 points	Increase 1 point	Increase 2 to 3 points	Increase 4 to 5 points	Increase 11%	Decrease 10 to 12%	Increase 6 to 7 C	Decrease 19%	Decrease slightly
Frequency	105% frequency	Decrease 10%	Increase 5%	Practically no change	Increase 5%	Slight increase	Slight increase	Slight increase	Slight increase	Slight increase	Slight increase	Decrease slightly	Decrease 5 to 6%	Decrease slightly	Decrease slightly	Decrease slightly
	Function of frequency	$\frac{1}{(\text{Frequency})^2}$	Frequency	.....	(Syn-speed slip)	.....	.....	.....	.....	.....	.....	.....	$\frac{1}{\text{Frequency}}$			
	95% frequency	Increase 11%	Decrease 5%	Practically no change	Decrease 5%	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Increase slightly	Increase 5 to 6%	Increase slightly	Increase slightly	Increase slightly

Note: This table shows general effects, which will vary somewhat for specific ratings.

tions and when the power plant load is very small.

The trouble could probably be avoided by installing the overload relays in the leads to the motor proper and adjusting them for the motor current (probably 6-8 amp) and protecting the capacitor with a separate set of fuses. (Fig. 4.) Or, if the motor is Y wound and the windings are tapped at 50 per cent for the capacitor, the relay coils could be connected between two of the phase windings and the neutral. (Fig. 5.)

General Comment

So much for the prize winning letters. As already mentioned, one of the best solutions was received after the contest closed and the awards had been made, the one submitted by Roland Berti. Mr. Berti's solution undoubtedly would have received first prize had it been received in time because it analyzes all factors of the problem in a most thorough manner. His letter follows:

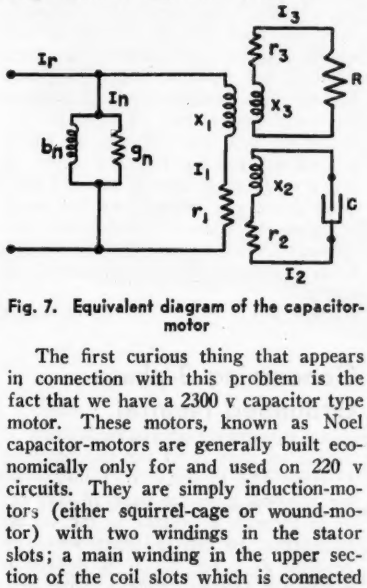


Fig. 7. Equivalent diagram of the capacitor-motor

The first curious thing that appears in connection with this problem is the fact that we have a 2300 v capacitor type motor. These motors, known as Noel capacitor-motors are generally built economically only for and used on 220 v circuits. They are simply induction-motors (either squirrel-cage or wound-motor) with two windings in the stator slots; a main winding in the upper section of the coil slots which is connected to the power source, and a second winding in the bottom section of the slots to which is connected the capacitor. This secondary winding is designed to step up the 220-v primary voltage to 660 v so that the more economical higher voltage capacitors may be utilized. The size capacitors used can be such as to correct the motor to either unity or 0.8 leading power-factor at full-load. It would have been as economical, and better from an operating and maintenance viewpoint to have used a standard 2300-v induction motor with a separate 2300-v set of capacitors. Thus in case of a motor failure, rewinding or replacement would be considerably cheaper and easier.

Figure 6 is a simplified vector diagram of the currents within this motor under normal operating conditions. A 25 hp, 2300-v, 3 phase, 1170 rpm induction-motor has a full-load efficiency of about 87 per cent, a power-factor of about 82 per cent lagging, and a full-load current rating of about 6.5 amp. This is indicated as I_m.

The capacitor is rated 15 kva, 13.1 amp at 660 v which means that it draws about 3.76 amp at 2300 v from the primary winding. This is shown as I_c which combines with I_m to give I_1, of about 5.3 amp at unity power-factor; which is the normal full-load current drawn by the primary stator winding from the line.

In general there are three factors (barring internal faults within the motor) that affect the current drawn by a motor; these are, mechanical load on the motor, impressed voltage, and frequency. With two of these factors constant and varying the third, the variations in current drawn, ranges for small changes from normal conditions approximately as follows: (1) in direct proportion to the load, (2) in inverse proportion to the voltage, (3) inversely as the frequency. The accompanying table which is reproduced from the Standard Handbook for Electrical Engineers shows the general effect of voltage and frequency variation on induction-motor characteristics.

The current drawn by the capacitor varies in direct proportion to the voltage and frequency.

Since the voltage variation has been measured and varies only a little more than 3 per cent under rated motor voltage it appears that we can rule it out as a factor; also since this is a good size municipal plant we can assume that the frequency is fairly well regulated and can also be ruled out as a cause of trouble. From the tabulations of head pressures, voltages, and current it can be seen that there is no consistency between load and current drawn. In fact in some cases the current drawn is less for some higher head pressure (with the same voltage) than it is for some lower pressure; just the reverse from what should be the case.

From Fig. 6 it can be seen that if the capacitor developed an open circuit the line current would suddenly change from I_1 to I_m. This would of course happen only once and then could be detected and corrected. However, since the rise in current is a recurring phenomenon, we can rule out a fault within the motor or capacitor, which would only occur once; and look elsewhere. This points conclusively to some other disturbing factor not yet accounted for, and the most promising suspect since a capacitor is involved, appears to be the presence of harmonics.

Shunt capacitors are sometimes (although rarely) the cause of a condition known as harmonic resonance. Sometimes when installed on distribution feeders for power-factor correction the capacitors and the line reactance are of just the right values to resonate at some harmonic usually the fifth or seventh (e.i. 300 or 420 cycles). The only impedance to the flow of current then is the resistance of the line with the result that excessive current will flow and blow the capacitor fuses.

Figure 7 is an equivalent diagram of the capacitor-motor in question. x_1 and r_1 are the reactance and resistance of the primary stator winding, x_2 and r_2 of the secondary stator winding, and x_3 and r_3 of the rotor, C is the capacitor, and R is the electrical equivalent of the load which acts as a resistance. In an ordinary induction-motor the capacitor circuit is missing. It can readily be seen that under stalled rotor conditions, R becomes a short-circuit and the only limitation to current flow is the impedance of x_1, r_1, x_3 and r_3.

Under ordinary 60 cycle conditions the capacitor circuit is preponderously capacitive, and is reflected back into the primary as a capacitance and draws leading current from the line. However, at or near resonance x_2 and C cancel out and the only limit to primary current flow would be the impedance of x_1, r_1 and r_2. Of course no motor designer would design a motor with x_2 of such a value that anything near resonance could occur. But it can be seen that whereas resonance would furnish a current several times full load rating (even with a harmonic voltage of only a few per cent of the fundamental), the capacitor circuit would not have to be anywhere near resonance to produce only a 13 per cent increase in line current.

To determine if this is actually the cause of trouble connect a recording-voltmeter and recording-ammeter in the capacitor circuit. If the current increases during the light load periods, with constant voltage, the presence of harmonics is certain.

The presence of harmonics can be further checked by the municipal plant engineers by means of a cathode-ray oscilloscope, or by a harmonic voltmeter. Where harmonics are present they are usually more predominant at light loads, partly because the line voltages on the system are higher. These higher voltages increase the system's transformers magnetizing currents and consequently the harmonic content. Also during light loads the absence of the damping effect of the load increases the harmonics.

To determine why these conditions are worse now after having been satisfactory for 12 yr requires a check on the ground. Such things as the recent installation on the feeder of shunt capacitors which might cause high voltage at light loads, voltage regulators, faulty transformers; or possibly a new unit at the power-plant which produces a poor voltage wave and is used during light load periods, might be the cause for increased harmonics.

As for correcting the trouble the best solution of course is to eliminate the harmonics at the source if possible. Otherwise about the only thing that can be done is to install small chokes or reactors in series with the capacitor leads to reduce the resonance effect.

Among the other solutions received were those by Carl Bachmann of Glenwood Springs, Colorado; Daniel S. Olafson of Elmwood Park, Illinois; LaVerne Greene of Rapid City, S. Dakota and Jesse L. Erisman of St. Louis, Mo.

LETTERS AND COMMENTS

Who Wants to Sell a Small Corliss Engine?

The following letter from the William Hood Dunwoody Industrial Institute explains itself. If any of the readers know where they might be able to purchase such an engine, please communicate directly with Mr. Craigo or with us.

Dear Sir:

Dunwoody each year trains large numbers of men entering or already in steam plant operation jobs.

We very much need a small Corliss Engine and it occurs to us that you might be able to put us in touch with individuals or companies who could sell us a used Corliss Engine at a special low price.

Dunwoody is a large privately endowed school operated without profit and charges very small nominal fees and is not in a position to purchase expensive equipment.

For some years we have been using a large oversize Corliss and this has been an inefficient piece of equipment for training purposes.

We would appreciate any information you may offer us in our mutual interest to be of service to those employed in steam engine operation.

R. T. CRAIGO
Assistant Director
The William Hood Dunwoody Industrial Institute
Minneapolis, Minn.

From Fingernail Biting to Hair Pulling

IT IS ALWAYS interesting to read of the other fellow's experience, especially when it is very much out of the ordinary. The following incident in the life of the writer will explain why we sometimes go from fingernail biting to hair pulling.

Several years ago the writer was engaged by a coal mining company in eastern Oklahoma as chief electrician. My first job with this company was to put into working condition the electrical equipment, or what was left of it, at a mine, the operation of which had been abandoned about 5 yr.

The power plant consisted of two hrt boilers and a 250 v, d-c generator, belt driven by a Corliss engine. The equipment at the plant, for all practical purposes, was intact. However, many of the motors, which had been used for driving pumps, fans, mine hoists, etc., ranging in size from 5 to 100 hp, were scattered all over the works with an end bell in one place, armature in another, field coils in another, and so on. Most of the field coils, however, were readily salable, and could not be found. Fortunately, nameplates were in place, which facilitated ordering new parts. It was therefore necessary to gather up all the pieces which could be found and try to fit them in their proper places preparatory to operation in so far as possible pending the arrival of new parts.

At one of the mine shafts which extended back under the mountain at an angle of about 15 deg with the horizontal, there was a 10 hp motor which was intact and had a nameplate speed of 750 rpm. The armature and four shunt coils were removed for test and drying out. Bar to bar test indicated the armature to be o.k. The field coils were tested for resistance with a slide wire bridge, the test indicating approximately the same resistance for each coil and about what would be expected of a shunt wound coil. The motor was cleaned up, field coils and armature given a coat of shellac, dried out and reassembled, preparatory to putting the fan in operation. "Here is where the trouble started."

The field coils were installed in the motor frame, connected up and given the old needle test for polarity. The armature was inserted and the end bells bolted up, connections checked, and the motor started without load. Instead of the speed being in the order of 750 rpm, however, it was in the order of 1050 rpm. This was about what would be expected with the polarity of one field coil reversed. Shifting the brushes did no good. The armature was removed and another test made for polarity. Same result. After tearing the motor down about three times, with the same result each time, fingernails were given a rest and the hair began to suffer.

It was then decided to put on the belt and see what would happen. When the load was put on the speed dropped to about 900 rpm and blue sparks about ¼ in. long shot out from under the brushes, and the armature began to heat rapidly. It was soon discovered that this was no go. It was then about 5:00 pm and we were preparing to call it a day. There would not have been much sleep that night for yours truly, however, but for a chance remark made by a coal miner who had just walked into the fan house. He walked in, looked around and said, "Where is them springs what wus in the corner that got red hot when the fan was runnin'."

That was all this writer needed in the way of explanation. It flashed to my mind immediately that this had originally been a compound wound motor, but had been operated as a shunt wound motor, and in order to hold down the armature current, which was excessive, due to the weakened field, homemade resistance coils had been made and cut in series with the armature. When we arrived at the power house, which was some half-mile from the mine, it was discovered that several shipments of material had been received, one box of which contained four nice new compound wound coils for this particular motor. They were installed the next morning and we had a nice smooth running 750 rpm motor. It just goes to show that in this old electrical game you cannot take too much for granted. However, to conclude that this was a shunt wound motor would certainly seem to have been justified in this case.

Raleigh, N. C. F. C. DEWEESE

Concerning 3-phase Grounded Neutral

IN READING the article by William T. Taylor on page 77 of the October issue I would like to know if I interpreted the problem given on page 78 correctly or if there is a mistake in the voltage to neutral. In Fig. 1, I have drawn the problem as I see it. It is desired to double the voltage, changing from delta to A. The voltages to ground would be 2080 and 3165 instead of the figure given—2800. Regarding the Table, it gives, in the original "T" system 57.7 per cent voltage from neutral to any one phase lead. This would mean, as I see it, that the "T" would have to be grounded at about 29 per cent voltage tap, as shown in Fig. 2. I would appreciate it if you would set me straight on the matter.

Oakland, Cal. H. D. CARRINGTON

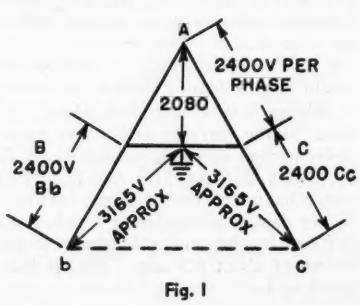


Fig. 1

We can all see with the naked eye that the Payroll Savings Plan provides the most stable method of war financing. Analyze it under the X-ray of sound economics and other important advantages are evident.

A continuous check on inflation, the Payroll Savings Plan helps American Industry to build the economic stability upon which future profits depend. Billions of dollars, invested in War Bonds through this greatest of all savings plans, represent a "high level" market for postwar products. Meanwhile, putting over Payroll Savings Plans *together* establishes a friendlier relationship between management and labor.

To working America the Payroll Savings Plan offers many new and desirable opportunities. Through this systematic "investment in victory," homes, education for their children and nest eggs for their old age are today within the reach of millions.

The benefits of the Payroll Savings Plan to both management and labor are national benefits. Instilling the thrift principle in the mind of the working men and women, the Payroll Savings Plan assures their future security—and is a definite contribution to the prosperity of postwar America!

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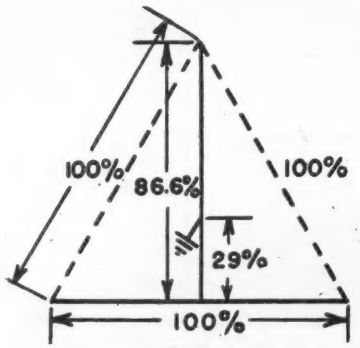

Fig. 2

ANSWER

Dear Mr. Carrington:

Your basic assumption is in error as the primary object of this system is to always obtain and maintain (for the same or any increase in phase voltage) a true NEUTRAL point, and to do so while retaining the same angular phase relations. Your sketch violates the primary principles of the system.

Whether you have a delta, a "V", a "T" or a "Y", the true NEUTRAL point (not merely a grounded point such as you have shown) remains the same.

The NEUTRAL point of a "T" system is equal to the "Y" system, i. e., 57.7 per cent. Your sketch (Fig. 2) should form an equilateral triangle in order to give three equal phase vector lengths, not as shown by you.

A simple way to look at voltage increase, using the "A" system, is given in Fig. 3 (A). Note the divisions of the phase windings which may consist of disused or spare transformers. Note that the original phase voltage consisted of 4-half windings in series per delta phase; that the first step-up of the distribution voltage consisted of 6-half windings in series per "A" leg and 4-half windings in the cross-bar; then the final (double) voltage step-up consists of 12-half windings in series per "A" leg and 8-half windings in the cross-bar as shown in Fig. 3 (B). The voltage step-up may be reckoned in percentage value increase above the original value in per cent.

N. Y. WM. T. TAYLOR

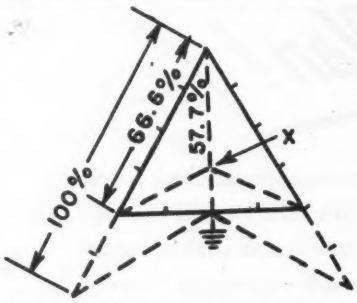

Fig. 3. (A) Showing conversion from delta or "T" to the "A" system such that the existing delta grounded point is used to form the new true NEUTRAL point of the "A" system with a phase voltage increase of 33.3 per cent. You will see that the original true neutral point of the delta and the "T" was at x

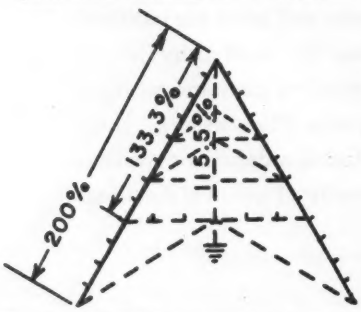

Fig. 3. (B) Showing conversion from the above to double the "A" phase-to-phase voltage, using the same original distribution transformers. As a general rule you may safely take it that this is possible for practically every ordinary distribution network because the transformation ratio and consequent voltage stresses are not too great

On Incompetent Engineers

HAVING read both of the articles by M.J.S. and W.T.M. carefully, I would like to add my comment too. During my 18 yr in the engineering field, I must say that I have been very fortunate in getting information from chief engineers, master mechanics, chief electricians and fellow engineers with the exception of a very few. The majority of the men with whom I have been associated in my time, have shown, sometimes with untiring interest, their willingness to co-operate with men under them in the advancement of their knowledge in the field of engineering. I have never had the misfortune to work for a chief or assistant chief engineer who refused or even hesitated to show me or explain anything or answer any question that I might ask. This is especially true where I work now. Our place has three steam producing plants and I have worked in all of them and any of the men in charge of these plants show a great interest in you when you ask a question about the plant. As I said before, this is very fortunate and from what I can learn from other men, it is also very unusual. It is for this reason that I never refuse to answer any question or show any man on my watch anything he wants to know, because it was through this source of good help, accompanied by hard study that I became an engineer. I don't doubt that M.J.S. and W.T.M. have very good reasons for their attitudes towards chief engineers. If I tried to answer their question as to why chief and operating engineers are so reluctant to tell other men something that might broaden his knowledge in the engineering field, I probably would just say "That you didn't strike the right guys".

There are many reasons why men are this way. First of all some men develop a "Superiority complex" when given any kind of responsible position. They seem to forget that there are thousands of men who hold the same jobs and could run circles around them. Another answer sometimes lies in the approach you make on a man or your attitude. A man feels often that he had to get the "know how" as best he could and he feels that the other fellows can do the same. By using a little psychology men of this type can be easily gotten around. Another reason lies in the fact that some men just naturally do not know. They were given the chance at the job and live in fear that someone will come along who will learn more about the job and take it from them. If I asked a man a question about the plant or concerning the trade and he did not give me a satisfactory answer, I would take it for granted that he did not know and I would not trust any information he did give until I had proof that it was correct.

Again, a great many times the chief engineer is held in restraint by his employer. If a man knows more, he is worth more and sooner or later he is going to ask for it and if he does not get it, he will take his knowledge where he can get it at his first opportunity. The management will not stand for any increases but still the chief is supposed to hold his men. So if he keeps them dumb, they don't stand much chance of going somewhere else. While this may be entirely against the chief's wishes, it is in many cases, his only recourse. W.T.M. is definitely correct when he says there are plenty of good chiefs. There is good and bad in anything and M.J.S. may have just struck a bad lot.

Baltimore, Md. CHAS. W. PARKS

Chief Engineers and $1500 a Year Men

I WOULD like to put in my two bits on "Chief Engineers" and "$1500 a Year Men."

Incompetent chief engineers and $1500 a year men are men who do not want to admit to themselves or to the world that they are too lazy to prepare themselves to be better men or to perform as better men.

The good chief engineer cannot possibly be a man who sees eye to eye in all respects with all kinds of men and in cases where a $1500 a year man cannot talk things over with his chief it is up to him to get a different job where he can do so; or, if he is a good man and can really deliver the goods better than the chief, it is up to him to convince the management of that and so have the chief replaced but I hardly think this to be the case very often.

The $1500 a year man who does not get along with his chief, before changing jobs, should consider the fact that people, the world over, are pretty much alike and it will be well for him to check up on himself to see if *he* is not really the one at fault.

What I would class as a good chief is a man that will take the time and pains to educate his men about all the phases of the work involved, who admits he does not know everything both to his superiors and to the men

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Fig. 2129

Fig. 2125

A BIG "PLUS" IN MOLDING

—skilled men and modern machinery. This craftsman cleans cores; removes all parting line edges, assuring smooth castings on inside.

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who, if graded by wages, are his inferior, and who will look up information he does not have and pass it on to others. A good chief who makes a false statement about some phase of the work and later finds out he was wrong will not hesitate to admit it to the man he made it to because he knows that sooner or later he will find out about it anyway. In other words, he is a man who will go to bat with and for his men both socially and professionally. The men, on the other hand will go to bat for such a chief when they can be of help to him.

It all simmers down to the fact that the chief and the men are paid out of the same purse and one should not feel superior or inferior to the other. If each takes the attitude of helping the other fellow neither need fear the day which always comes, when they need a boost.

The average $1500 a year man learns to perform a certain act by being shown rather than by being taught the underlying theory, partly because of his lack of desire to know, partly by his inability to learn and partly because of the fact that those over him do not care to take the time to teach him. This method of training operators is reasonably satisfactory but fewer mistakes will be made and operators will be more satisfied if they understand how to analyze the reasons behind their various operations. Under such conditions, the chief, also can go home and rest assured that all is well in his absence.

There is a satisfaction in knowing you are master of your actions and that you are doing the only right thing possible under the circumstances.

Rapid City, S. Dakota L. A. G.

Questions And Answers

Question No. 284

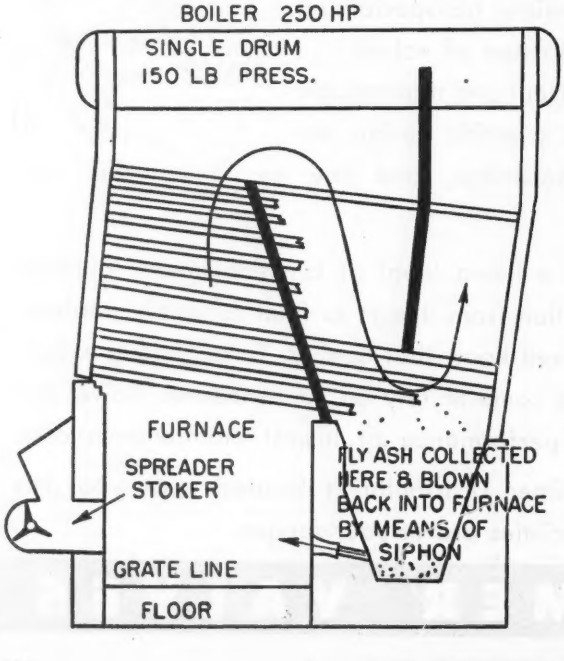
Will Baffle Extension Decrease Fly Ash?

WE RECENTLY installed a spreader type stoker on a 250-hp straight-tube boiler, which has two baffles as shown in the sketch. We are suffering considerably from fly ash. We have eliminated some of this fly ash by the use of over-fire steam nozzles. However, that is not the complete answer.

The rear baffles rest on the 4th row of tubes from the bottom. We are thinking about extending this baffle to possibly 6 in. below the bottom row of tubes. In your opinion, would this addition to the rear baffle reduce the velocity of the gases flowing around the bottom of this baffle and thereby permit the dropping out of most of this fly ash?

The fly ash has considerable combustible contents. The coal is ⅜ in. in size, containing a considerable portion of fines.

Ambridge, Penna. F. R. K.



Diagrammatic sketch of F. R. K.'s straight tube boiler setting with spreader stoker, showing baffling and present method of reinjecting fly-ash

Question No. 285

Does Motorizing of Generator Reverse Its Polarity?

IN OUR PLANT is installed a motor-generator set for battery charging. The entire installation is designed to supply power for switchboard control and emergency lighting. Ordinarily the battery floats on the line and it picks up the load when the regular power supply fails. Occasionally the reverse current relay on the breaker between the battery and generator fails to function properly. The breaker stays in and then the battery motors the M. G. Set. This action, motorizing the generator, does not reverse the polarity of the generator. Why is this? When the set is again placed in service, the generator builds up voltage as usual.

The name plate on the generator states it is: Type OD55; shunt wound; amp 21.4, volts 140; speed 1500; 3 kw; continuous 50 C.

Montebello, Calif. W. T. P.

Question No. 286

How Is Steam Released in Fire-tube Boilers?

I HAVE READ with much interest the article How Steam Is Released in Water-tube Boiler Drums by Max H. Kuhner in the September, 1944 issue of POWER PLANT ENGINEERING. The article is certainly very clear and concise and together with the fine illustrations, presents the subject in a way very easily understood.

My interest, however, is primarily in the field of the various fire-tube types of boilers, with which I have had considerable experience during the past 15 yr, especially in sizes below 300 blr hp and pressures below 300 psi. I wonder, therefore, if there is any similar recent information on fire-tube boilers, in which the steam is necessarily released through and from the water surface.

It is true that some textbooks on boilers discuss this subject but most of the books I have seen are quite old. What I would like especially is some recent information obtained possibly from fire-tube boilers of modern design, at maximum rates of firing principally with gas or oil, with a minimum amount of heating surface consistent with high overall efficiencies.

Los Angeles, Calif. C. C. S.

Editor's Note:—The above is presented as typical of a number of letters we have received commenting very favorably on Mr. Kuhner's fine article in the September issue.

We have already passed the question along to a number of the manufacturers of fire-tube boilers.

It will be remembered that the article

FACTS YOU SHOULD KNOW ABOUT THE STEEL VALVE

OUTLOOK FOR 1945

An annual report to steel valve users

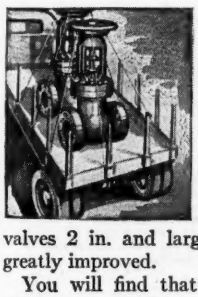
THERE'S good news in this annual report.

Throughout the entire war period, steel valves have been one of the most critical common components in American war production. As a consequence, though the industry's capacity has greatly expanded, the extremely high demands of Navy, Maritime Commission, 100-octane, synthetic rubber and other top-rated war programs have syphoned off the great bulk of steel valve production.

The 1945 outlook is more encouraging, however. Not only from the standpoint of deliveries, but also because it will bring the introduction of new products, new materials and new processes which are the result of the war-time development work of the steel valve industry engineering and laboratory staffs.

FIRST, ABOUT DELIVERIES

For the early months of the year, the smaller forged steel valves will continue to be rather tight. The smaller sizes will probably still be needed in large quantities for urgent war programs at least through the first quarter of 1945. The delivery outlook for most types of steel valves 2 in. and larger appears to be greatly improved.



You will find that if you do three things you can shorten deliveries of the steel valves you need:

1. Stick to standard valves. Continuing manpower shortages may make "specials" take about as long as they have the past few years.

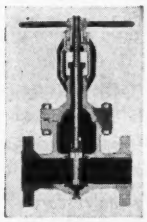
2. Use a substitute if you can. If the exact type of valve you want is oversold, check with your valve source to see if there isn't another valve available which will do just as well.

3. Check your order. Many delivery delays come from incomplete product description, service requirements or priority information on the order.

NEW DESIGNS, BETTER VALVES

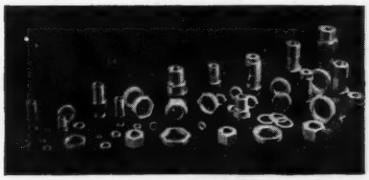
A lot of new refinements are being introduced to make your steel valves better valves.

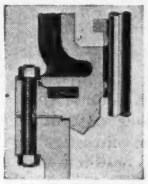
For instance, during the past year Edward has introduced, along with dozens of individual valve improvements, three major design advances:



1. A new, basically different gate valve, incorporating all six of the improvements operating men most wanted in their postwar gate valve. If you would like a complete description of this valve, write for Catalog 12-E.

2. EValizing, a new exclusively Edward plating process to add years of trouble-free life to valve parts most subject to abrasion and galling. Valve bonnet threads, junk rings, high temperature bonnet stud nuts and other Edward parts are now EValized as standard Edward manufacturing procedure.



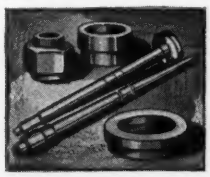


3. EVinlay, another life-lengthening Edward development for hard surfaced inlays on the high load bearing surfaces of high pressure and temperature valve parts.

During 1945 additional new products and developments, already well past the experimental stage, will be introduced. The steel valve industry faces many new problems since it is evident that substantial post-war expansion in many industrial fields calls for increasing temperatures and pressures. Steel valves will be needed in many processes and services where iron, brass or other materials were satisfactory before. Our laboratories, the most completely equipped laboratories devoted entirely to steel valve research in the country, have accumulated a great deal of significant data on the performance of various materials for many of the new manufacturing processes to be introduced in the post-war period. This development work has in no way interfered with our war production, however, for two more Gold Stars were added to our Maritime "M" pennant during 1944.

PARTS BUSINESS UP

Orders for steel valve repair parts are increasing as equipment continues to run long hours under heavy load. The Edward production department operates under the unvarying policy of giving parts orders preference, since we recognize that a part order usually represents an actual or expected operating interruption. Within the limitations of government regulation we will continue to emphasize prompt filling of repair part orders. It isn't, by the way, a very large portion of our business. Steel valves, in normal service, require relatively very few part replacements.



PROJECT PROBLEMS?

Possibly you have an expansion, reconversion or rebuilding program scheduled for the coming years. If you do and steel valves are involved, we'll be glad to consult with you on any problem that may arise. As the largest exclusive steel valve builder and a pioneer in the field, our development staff has had wide experience on boiler room, petroleum, industrial, technological and marine work. That experience is yours for the asking.

W. F. Crawford *President*

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EAST CHICAGO INDIANA

by Mr. Kuhner rose out of some discussion of three questions that were submitted to us:

1. What is the correct steam disengaging surface in boiler drums per 1000 lb of steam output or per boiler horsepower, for various working pressures and ratings?

2. What steam storage space should a boiler have?

3. How high should the steam takeoff be above the working water level?

In regard to modern water-tube boilers, because of their construction and circulation, because of the extensive use of steam washers and other factors, these questions do not seem to have much practical significance, especially for the boiler operator. In fact, they introduce misleading conceptions. This was clearly explained by Mr. Kuhner.

Do the questions have any more significance in regard to the HRT boiler, the Scotch boiler, the vertical fire-tube boiler? If any Q & A readers have any comments or information about steam release in these types of fire-tube boilers, with any types of coal, gas or oil firing, we'll be glad to have them either as answers to this question or to be considered as a separate article.

The best textbook information along these lines that we can find, referring specifically to fire-tube boilers, is contained in The Design of Steam Boilers and Pressure Vessels, by Haven and Sweet; 2d Edition, 1923; John Wiley & Sons, Inc., New York; pages 212-216. Some boiler manufacturers, while giving data they use in such cases, seem to feel that so much judgment is required in these designs, based on long operating and design experience, that they do not care to specify numerical values too rigidly.

Answer No. 275

What Is the P-T Relation at The Freezing Point of Water?

Editor's Note—Behind this apparently theoretical and "high-brow" question lies a story of importance and interest to power engineers and especially to all those concerned with refrigeration. The question was asked by W. E. P. in the November issue and in his original letter asking the question he made the following comments:

The writer has had occasion to investigate the causes of failure of various types of demountable pipe and tube fittings, used on refrigerant lines and subject to alternate freezing and thawing conditions, which failed by progressive deformation or even rupture, due to force originating by repeated freezing and expansion of moisture, usually condensation, in clearance spaces.

This brings up the question of how much pressure can be exerted by the freezing of moisture in a confined space at various temperatures.

We have not encountered any tables covering such a relationship. After presenting the question to several nationally prominent engineers in the now popular low temperature refrigeration field only to learn that the question had never occurred to them, we wonder if we merely have a kindergarten item? Or is it true that data are not commonly available on such an ordinary occurrence as the conditions attending the simple freezing of water?

In our reply to W. E. P.'s original letter, we referred him to the following table, appearing on page 1696 of the Handbook of Physics and Chemistry, 25th Edition, published by Chemical Rubber Publishing Co., 1900 West 112th Street, Cleveland, Ohio.

MELTING POINT OF ICE — VARIATION WITH PRESSURE

Temperature Degrees C	Kg per sq cm (abs)	Lb per sq in. (abs) (Approx)
0.0 C	1.0	14.223
—2.5	336.0	4790.0
—5.0	615.0	8750.0
—7.5	890.0	12,700.0
—10.0	1155.0	16,400.0
—12.5	1410.0	20,000.0
—15.0	1625.0	23,100.0
—17.5	1835.0	26,000.0
—20.0	2042.0	29,000.0
—22.1	2200.0	31,200.0

We also referred him to the research work on very high pressures by P. W. Bridgman, in whose books we had seen this subject referred to. W. E. P. has just replied in the following very informative and interesting letter:

We have found the same melting point pressure relationship data on page 1754 of the 27th edition of Handbook of Chemistry and Physics 1943-44, with the exception that pressure was given only in kg per sq cm and suspect that you were kind enough to transpose it to lb per sq in. (Very approximately on the slide rule—Ed.)

Also we were able to locate a copy of Physics of High Pressure by P. W. Bridgman, Ph.D., published by G. Bel and Sons, Ltd., London, 1931. On page 199 of this book, we find the following:

"In almost all cases, the melting curve rises with increasing pressure, corresponding, of course, to the fact that the liquid usually has a larger volume than the solid. Only three cases of falling melting curves have been investigated under pressure — bismuth, gallium and water.

"The curvature of all these is downward, which means that as pressure increases, the abnormal drop of melting temperature becomes accentuated. This suggests some sort of instability in structure and in fact, in the case of water, there is such instability, and beyond 2200 kg per sq cm, ordinary ice is replaced by another more stable form which will be discussed in greater detail later." (These general relations are illustrated in the curves of Fig. 1.)

Page 209 of Bridgman refers to ice I, II, III, IV, V, and VI but does not explain the distinctions, nor could we find any further mention of the subject in the book.

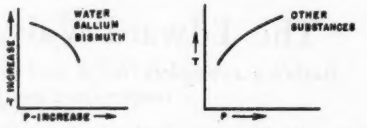

Fig. 1. Curves showing general relations of pressures and temperatures of various substances as given by P. W. Bridgman

All in all, we are getting off into fairly deep water, or maybe it is deep ice.

Just in case you are interested in the reason for all this discussion, we are enclosing a copy of a patent and a drawing of ours which we hope is self-explanatory.

In supervising the maintenance of some five hundred defrosting cycle refrigeration systems used in grocery stores, we found repeated instances where standard forged brass SAE flare couplings were leaking, due to the nut becoming loose on the fitting.

These couplings were exposed to a temperature cycle of from 38 F to 14 F and making about 3 cycles per hour. (Above troubles are not encountered unless cycle goes above and below 32 F.)

We suspected that repeated expansion of condensation, freezing in the clearance space between the nut and the fitting, was providing the force that dilated the nut as a permanent deformation. A nut specially designed to relieve this force was the final answer and we have had some 15,000 of these installed for three and four years to prove that the idea works 100 per cent. (This design has been patented by W. E. P. and the patent assigned to the manufacturer of these fittings.—Ed.)

At A in Fig. 2 is shown the effect of the alternate freezing and thawing of moisture collecting between tube and nut.

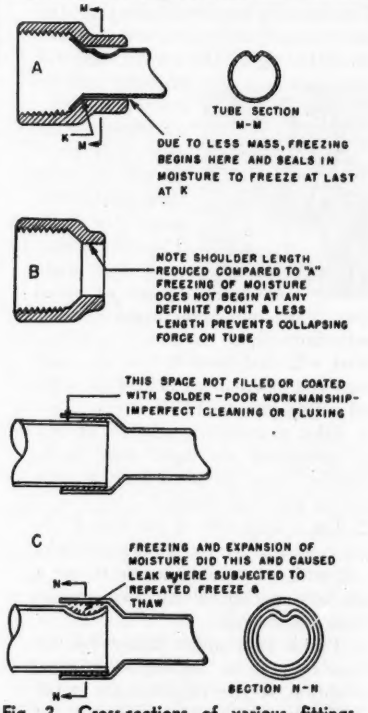
A
M
K
M
TUBE SECTION M-M
DUE TO LESS MASS, FREEZING BEGINS HERE AND SEALS IN MOISTURE TO FREEZE AT LAST AT K
B
NOTE SHOULDER LENGTH REDUCED COMPARED TO "A" FREEZING OF MOISTURE DOES NOT BEGIN AT ANY DEFINITE POINT & LESS LENGTH PREVENTS COLLAPSING FORCE ON TUBE
THIS SPACE NOT FILLED OR COATED WITH SOLDER — POOR WORKMANSHIP — IMPERFECT CLEANING OR FLUXING
C
FREEZING AND EXPANSION OF MOISTURE DID THIS AND CAUSED LEAK WHERE SUBJECTED TO REPEATED FREEZE & THAW
N
N
SECTION N-N

Fig. 2. Cross-sections of various fittings, showing faults causing leaks under repeated freezing and thawing

Collapse of the tube diminishes the effective cross-section but ordinarily does not cause leakage unless the flare edge is pulled away from the fitting.

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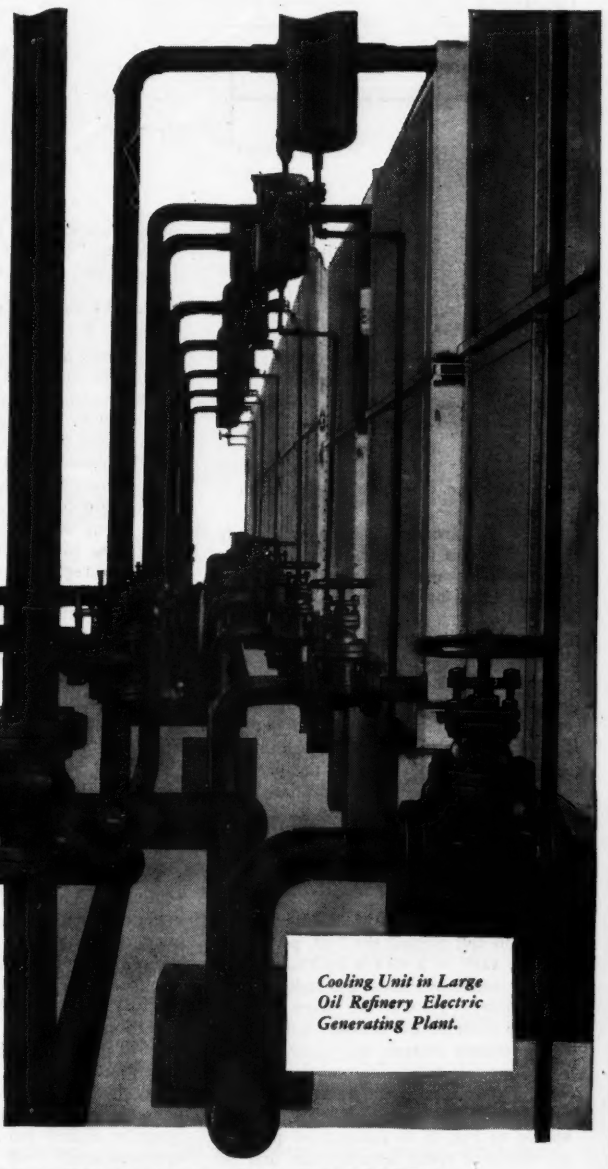

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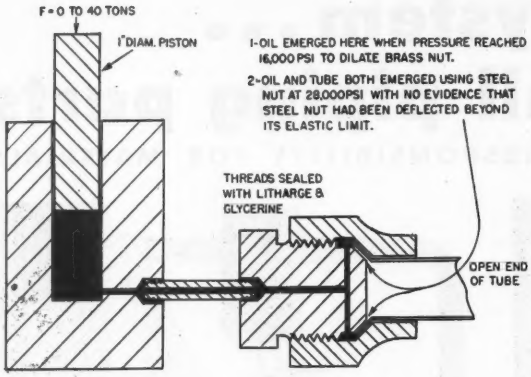
F=0 TO 40 TONS
1"DIAM. PISTON
1-OIL EMERGED HERE WHEN PRESSURE REACHED 16,000 PSI TO DILATE BRASS NUT.
2-OIL AND TUBE BOTH EMERGED USING STEEL NUT AT 28,000PSI WITH NO EVIDENCE THAT STEEL NUT HAD BEEN DEFLECTED BEYOND ITS ELASTIC LIMIT.
THREADS SEALED WITH LITHARGE & GLYCERINE
OPEN END OF TUBE

Fig. 3. Diagram of W. E. P.'s test apparatus to determine pressures necessary to stretch flare nuts of various metals

To prevent this collapsing action, flare nuts have been made with less shoulder length as at B, Fig. 2 but these do not support the tube as effectively as the long shoulder.

It might also be of interest to note that joints on copper tube with sweat or solder type fittings are also subject to rupture by alternate freezing and thawing, when their entire mating surfaces are not coated with solder or any spaces not completely filled, as at C, Fig. 2. This is equally true when silver alloy solders are used.

It was learned that another remedy to the problem in the above temperature range was to use flare nuts of greater wall thickness made on special order, but the cost of such items was too high commercially.

However, the question still in our minds was: Just what pressures were being developed in the above temperature range? Your table has verified our experiments very nicely.

As a means of learning the pressure necessary to radially stretch flare nuts of various metals, we built as a pressure source 1-in. diameter steel piston, lapped to fit a 1-in. bore in a 2½-in. diameter steel cylinder, as shown in Fig. 3.

By filling this 1-in. cylinder with heavy oil and placing the 1-in. piston under the ram of a 40-ton hydraulic press with a calibrated pressure indicator on the primary system, we were able to roughly compute the pressure achieved in the secondary system.

A special, solid, internal-flare fitting was prepared, with the exception that a longitudinal passage was drilled, as shown in Fig. 3, to conduct oil pressure to clearance space between nut and fitting, a short piece of flared copper tube was installed and the nut assembled using litharge and glycerine to seal the threads.

Using a standard forged brass ½-in. OD tube size flare nut, without our vents, at 16,000 lb per sq in., the nut stretched and allowed oil to come out past the flare.

Using a steel flare nut at 28,000 lb per sq in., the flare was collapsed and the copper tube extruded from the nut.

We note now that the 16,000 lb per sq in. figure of yield point in our experiment is, by your table, equivalent to the pressure exerted by ice at −10 C or +14 F and it was at +14 F that the fittings failed in the field installation.

Data on P-T Relations from Lancaster

W. E. P. WANTS TO KNOW whether water would always remain in the liquid state if the temperature of a volume in a container strong enough to prevent the expansion in volume that would ordinarily occur with freezing, were lowered indefinitely. He also wants to know about the pressure-temperature relationship for water at the transition point from the solid to liquid phases. Answering his questions in brief (but in the reverse order from that in which they were asked) (1) there is a definite temperature-pressure relationship governing the change of water from a liquid to a solid state, but (2) the temperature at which a volume of water sealed in a container will freeze cannot be determined from this relationship without detailed knowledge of the size and shape of the container and knowledge of the physical properties of the material from which it is made.

As water increases in volume when undergoing the change from a liquid to a solid state, an increase in pressure (which resists this volume change) lowers the temperature at which the change of state occurs. However, the change in the freezing point is not of as great an order of magnitude as W. E. P. assumes. According to the International Critical Tables, a pressure of 1500 psi lowers the freezing point to approximately 30 F. The freezing point becomes lower with increasing pressure until at a pressure of approximately 30,000 psi it is a minimum, approximately −8 F. At pressures above 30,000 psi, ice with a slightly different structure is formed and the freezing point increases with an increase in pressure until at approximately 90,000 psi the freezing point is again 32 F. Higher pressures produce still higher freezing points.

The question as to the temperature at which freezing would take place if a volume of water were placed in a closed container and the temperature lowered cannot be answered without specific knowledge of the properties of the container used because, while the above-mentioned pressure-temperature relationships will always hold, the pressure inside the container depends upon a number of factors, among which are: (1) the temperature-volume relationship for the water (thermal expansion or contraction), (2) the pressure-volume relationship for the water (compressibility), (3) the changes in the volume of the container because of deformation of the container by the internal pressure produced by the change in temperature of the water, and (4) the changes in the volume of the container because of thermal expansion and contraction. It must be remembered that, no matter how strong the container, there will be some deformation when it is subjected to an internal pressure. Although this deformation may be of a magnitude that would ordinarily be considered negligible, it may be highly significant in this case because water is a relatively non-compressible fluid and hence very slight volume changes will result in very large pressure changes.

New York, N. Y. J. E. LANCASTER

Answer No. 276

How Improve This Domestic Furnace?

Concentrate on Heating System, Not Firebox

IF THIS HEATING PLANT is a two pipe system, as I think it is at that age, and only four or five rooms are in use, surely they are on the first floor.

Fill the system with water to top of first floor radiators, place a thermometer on the boiler for a guide to the heating, leave pressure gage on, let air out of system at second floor radiators. Water is a much better conductor of heat, holds heat longer and can be regulated more evenly.

As for the firing, don't disturb the outer edge of the firebox. This is your real heating surface. I suggest you try firing the boiler with a cone-shaped fire, covering the center or top of the cone with ashes 3 or 4 in., tapering off to the edge. Never use a poker in the fire. Shake grates enough and, where more heat is needed, this lets the fire burn around the outer edge where it does the most heating.

This boiler should have a damper in the smoke pipe and can be set to regulate the heat with a thermal regulator to control the air for combustion.

Put in a new fire only when it has burned across the top, and the house is warm.

A sheet metal box can be made, about 18 by 24 in. and 36 in. long, placed across the smoke pipe in the 24 in. side and at top end near the boiler, with a baffle in center from the top of box to within 10 in. of the baffle before being discharged. A heating coil connected across from return line to discharge line of boiler and placed on the front side of the baffle, with about 10 to 15 sq ft heating surface, will generate steam and force circulation in the heating system. This replaces the circulating pump. The

HOW TO MAKE STEAM COSTS "STAY LICKED"

Fuel-Saving Starts With CONTROL

IT'S ONE THING to win skirmishes in the endless war against high steam costs. It's quite another to find the winning tactics that rout fuel waste and high costs — that make them *stay licked.*

That's exactly how numerous executives—*shrewd strategists*—are winning on the boiler-room front: by utilizing Automatic Combustion Control. Hays Combustion Control *electrically* operated, measures every combustion factor, records every variation, instantly corrects those variations. It's simple, error-proof — AUTOMATIC.

With plant capacities straining to meet war materiel needs, with new equipment barred, with man-power restricted, many plants have found Hays Combustion Control ideal and practical. It saves man-hours, works tirelessly, 24 hours a day . . . gets the utmost efficiency—cuts operating costs.

Smart tactics: send now for the Hays Combustion Control Catalog full of useful steam-power data, "must" literature for industrial strategists.

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HAYS *Automatic* COMBUSTION CONTROL

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box heats the basement, otherwise the heat would be wasted.

These ideas have been carried out for five years with a boiler that was too small but now has plenty of heat with some to spare, with fuel consumption much less than before. Fired on coke should be similar to anthracite, due to the carbon and low volatile content.

Cincinnati, Ohio — J. D. WARD

Answer No. 277

Why High Potential to Ground But Little Current?

Condition Cited is Normal; Capacity Effect Important

THE CONDITION cited by H. E. A. is quite a normal one; it indicates, in fact, satisfactory system insulation conditions.

There is for each conductor of a 3-phase, 3-wire, delta, 60-cycle system a certain capacity value, as well as insulation resistance value to ground, the capacity value having the most observable effect. Theoretically, with perfect conditions, the value between each conductor and ground would be $440/\sqrt{3}$ or 254 v, so it is not at once apparent why the test values given should be 185 and 190 and 185 volts; the fact that all three values are practically the same, however, indicates equal relations to ground.

This is illustrated by Fig. 1. Voltages 1-2, 2-3 and 3-1 are line-to-line voltages; 1-0, 2-0 and 3-0 are line-to-ground voltages due to capacities C_1, C_2 and C_3. The equality of the three line-to-ground voltage indicates a balance because, when combined in their vector (angular) relation, the resultant is zero or virtually so.

It should be pointed out that in any delta-connected system the neutral point

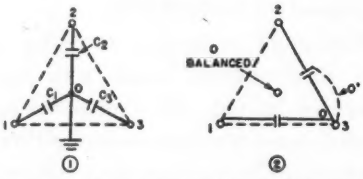


Fig. 1. Diagram showing theoretically perfect conditions, all values in balance
Fig. 2. Diagram by Von Dannenberg showing shift of neutral point 0 to 0' if conductor 3 is assumed grounded

"0" is apt to take any position, or "float" as it is technically referred to, due to change in conductor relations to ground. This is particularly true when the system feeds overhead line circuits subject to changing weather conditions or contact with foliage, where one rarely finds the voltages from conductor to ground as closely balanced as given by the questioner.

The extreme condition is that resulting from a "dead ground" of one conductor; the condition would then approximate that shown in Fig. 2, where conductor 3 is assumed grounded. This results in neutral point 0 shifting to 0' and the voltage to ground from line 3 being practically zero. On the other hand, the voltages to ground from lines 1 and 2 to 0' increase and under suitable conditions may cause serious trouble. This is due to the flow of capacity (charging current) to ground through the faulting of line 3; the more extensive the system, the greater is the capacity to ground and the greater the charging current flowing through the fault. This may in time char the insulation and cause a serious breakdown if continued for a lengthy period, so if a ground detector indicates a system ground, even though no interruption or trouble occurs, it should at once be traced to its location. This condition is not present in a star (Y) connected system with a grounded neutral where a faulted conductor gives immediate indication. There are some ramifications which may or may not be pertinent. Concerning the voltages to ground given, which I mentioned were not apparent in their value, although their equality indicated satisfactory insulation from the system, a practical condition arises.

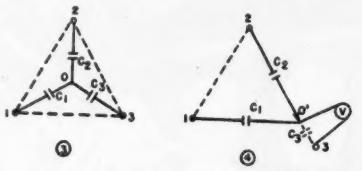


Fig. 3. Diagram by Von Dannenberg showing normal theoretical conditions
Fig. 4. Diagram by Von Dannenberg, showing conditions if voltmeter is used to measure line-to-ground volts

Actually the volts to ground should be $440/\sqrt{3}$ or 254 v for a perfect condition. When a voltmeter is used for measurement of line-to-ground volts, see Fig. 4, the capacity C_3 is shunted, so with the average low impedance a-c meter this would upset the capacity balance and the reading obtained would be due to the vector sum of the currents through C_1 and C_2. So the reading would not be a true one for volts from line to ground. If three separate voltmeters had been used and read simultaneously, possibly different results would have been obtained. Actually the only method to assure a correct result would be to use a meter of the static type, known generally as a multicellular voltmeter. The Westinghouse and G. E. Co.'s ground detectors are good examples and since all meters of this type take no current, the static balance is not upset.

Perhaps the foregoing is getting a bit too technical or delving too deeply to present the story for an essentially practical man but I did not, at first glance, fathom the oddity of the readings given, all below 200 v for a 440-v delta-connected ungrounded system.

In any event the closeness of the three readings given in the question indicates far better conditions than one usually finds and if, as I presume, each reading was taken alone the condition for each reading was essentially the same.

These apparently simple questions lead to many paths when all elements are considered. It is not unlike measuring insulation resistance with a low resistance meter.

Brooklyn, N. Y. — C. O. VON DANNENBERG

Answer No. 278

He Wants to Know About Dehumidification of Air

Absorption and Adsorption Systems

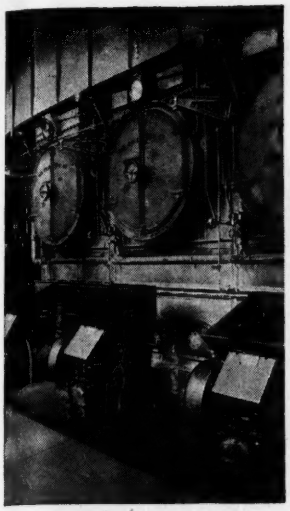
THE BEST WAY for A.B. to get the information on dehumidification of air for industrial use is to write to manufacturers who specialize in this type of equipment (whose names and addresses may be obtained from the ASME Directory and Catalog or from any other buyer's guide) giving full details as to the quantity of air to be dehumidified and the final conditions of temperature and humidity desired. They will be more than glad to make recommendations as to processes and equipment to do the job.

Although specific suggestions could not be made for A.B's case without more information, a brief discussion of dehumidification systems might be in order. The two principal types of systems for industrial use are absorption and adsorption systems.

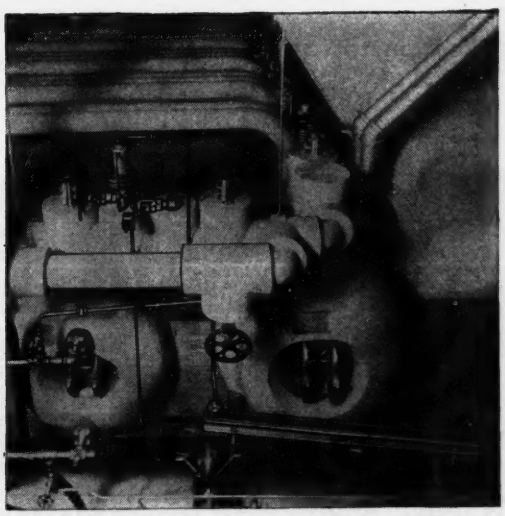
In absorption systems the moisture from the air is absorbed in water solutions of highly soluble chemicals (such as calcium or lithium chloride). The solutions have the property of trying to become more dilute, as it were, by absorbing any moisture in the air with which they come in contact. This absorptive power is a function of the strength of the solution. Thus the moisture content of the leaving air may be controlled by controlling the strength of the solution. The solution is brought into contact with the air by being sprayed into, or allowed to fall in sheets through, the contact chamber through which the air is being forced. The water is removed from the solution by evaporation.

In adsorption systems the moisture is removed from the air by being entrapped on the surface of a porous substance (such as silica gel). The structure of the substance is such that the ratio of surface to weight is large. The air is usually passed through beds of finely divided substance. When the substance has adsorbed its full capacity of moisture it may then be reactivated (i.e., the moisture removed) by the application of heat. The reactivation may be either intermittent or continuous. In the intermittent systems, two or more identical units are used, interconnected so that any one may be reactivated while the others are being used for dehumidification. In the continuous system the bed of drying substance is continually in motion, passing alternately through the chamber in which it is in contact with the air to be dried and through the reactivation chamber. Either oil or gas combustion or high pressure steam may be used for reactivation.

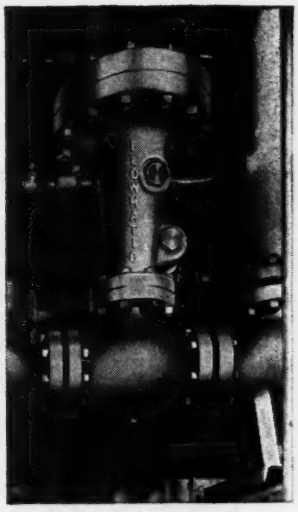
New York, N. Y. — J. E. LANCASTER



Atlanta Ice & Bottling Co., Atlanta, Georgia. 3 Copes Type OT Regulators installed on HRT Boilers operating at 100 pounds pressure.



Industrial Plant. One of two feed lines to 650-pound pressure C-E Boiler handling a peak of 150,000 pounds per hour, controlled by a Copes Type BI Regulator and Type 3-S-2 Differential Valve.



Eddy Paper Corp., White Pigeon, Mich. Direct-operated Copes Flowmatic Regulator Valve on 550-pound Badenhausen Boiler.

There's a COPES *Feed Water Regulator*
FOR EVERY BOILER REQUIREMENT

SMALL BOILERS?

For HRT, Scotch Marine, and other small boilers, the Copes Type OT Regulator is ideal. Extremely simple, easy to install, compact, direct operated.

Sizes ¾" to 2", 250 and 300 lb. stds.

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For the conventional water tube boiler subject to ordinary loads, the Copes Type BI Regulator is universally the best known simple level regulator. Fully automatic, thoroughly reliable, smooth acting. Direct or relay operated. Sizes ¾" to 8" all pressure stds.

SENSITIVE BOILERS?

For boilers subject to severe load fluctuations or those sensitive to shrink and swell, the Copes Flowmatic is the correct answer. This steam-flow water-level control is the most rapidly accepted development of recent years. Direct or relay operated.

Sizes 1½" to 8", all pressure stds.

To be most effective, your feed water regulators must be suited to the particular requirements of the boilers they serve. Boiler design, firing methods, operating procedures, load demands, and space limitations all require consideration.

Whatever your boiler plant characteristics, you will find a Copes Feed Water Regulator that is "made to order." For we manufacture simple level regulators and steam-flow water-level controls in several types, both direct operated and remote relay operated. In addition, every control valve is provided with plunger and ports designed for the existing pressures, temperatures, and rates of flow.

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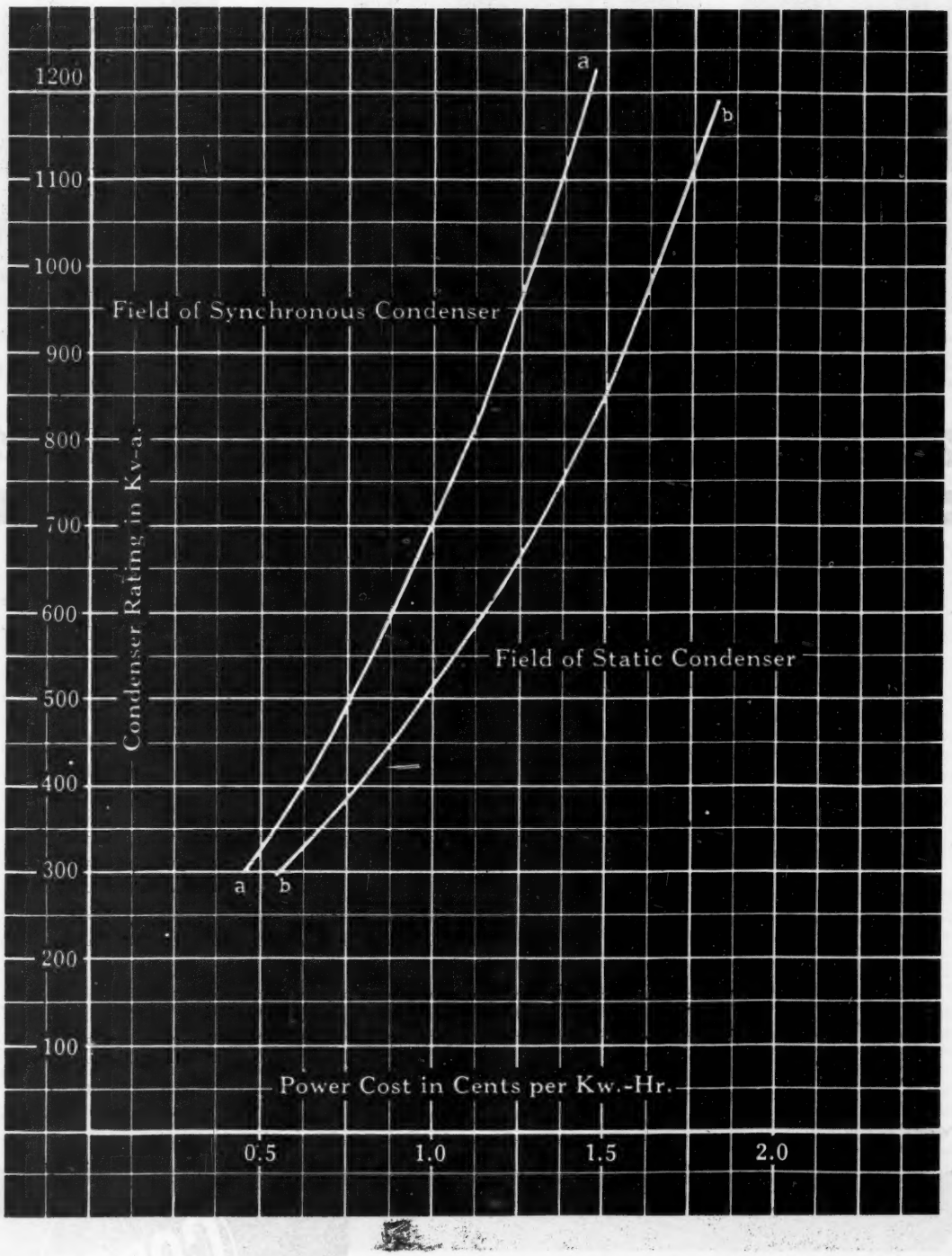

This chart which was prepared by engineers of the Westinghouse Electric & Mfg. Co., contains consideration of the following factors: 1, Investment; 2, Fixed Charges—15 per cent of the initial investment; 3, Schedule of operation—Two operating schedules were considered, one for 2400 hr per year and another for 3100 hr per yr; 4, Energy rate—comparisons were worked out on the basis of energy costs ranging from ½ to 2 c. per kwhr; 5, Maintenance and attendance.

Curve aa represents division on basis of 3100 hr of operation per yr. Curve bb represents division on the basis of 2400 hr of operation per yr.

SOLNUS OILS...

end carbon trouble, cut diesel shutdowns in half

An ice and cold storage plant in central Pennsylvania was all heated up about diesel oils. They had two diesels, both direct-connected to ammonia-compressors, and both driving generators by belt drive.

Heavy carbon deposits were sticking the rings and blocking exhaust ports and pipes. Twice a year the diesels had to shut down to have carbon scraped.

Three and a half years ago, a Sun Diesel engineer recommended the proper grade of Sun's Solnus oil for these engines. Since then rings, ports and pipes have been clean. Engines are shut down only once a year, and oil remains clear.

This is just one of the many current cases on file at Sun, which illustrate how the combination of Sun's engineering experience, plus Sun's proved line of diesel lubricants have saved money and eliminated headaches for operators.

Whatever equipment you operate . . . whether diesels, gas engines, gasoline engines, steam engines, turbines or electric motors . . . Sun's industrial products and "know-how" can help you.

SUN OIL COMPANY · ***Philadelphia 3, Pa.***

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SUN INDUSTRIAL PRODUCTS

OILS FOR AMERICAN INDUSTRY

Removal of Ammonia from Boiler Feedwater

Liberated ammonia attacks copper alloys in piping and tubing, copper solutions in boiler plate heating surfaces and causes corrosion . . . Three methods are given for removal of ammonia

By C. E. Joos, Sales Manager, Apparatus Div. Cochrane Corp., Philadelphia, Pa.

WITH THE DISCHARGE of sewage into streams and increase in pollution that may be caused by industries, power plants are occasionally brought face to face with the problem of removal of ammonia from their feedwater supply. Ammonia, when liberated with the steam, will have a deleterious effect on copper alloys, and be destructive to valves, heat exchangers, piping, condensers, etc. Where ammonia is permitted to accumulate, at that point deterioration is relatively rapid.

In addition to this, ammonia in dissolving copper alloys, will cause this metal to be carried over to the boiler concentrate, plate out on the boiler tubes, and be causative of corrosion and failure.

For the removal of ammonia, various methods may be employed; the principal methods that have been placed into practice to date and have been satisfactory are:

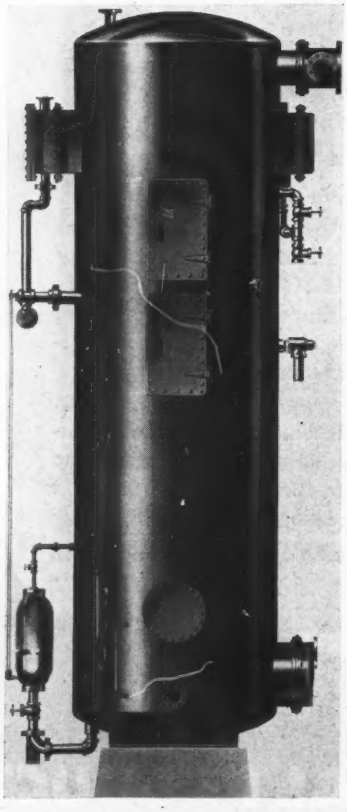

Fig. 1. External view of deammoniator

(1) The chlorination of the water supply, which oxidizes the ammonia to nitrogen and hydrochloric acid.

(2) Removal of ammonia by mechanical means.

(3) The removal of ammonia by passing the water through an acid regenerated resinous ion exchanger.

Use of Chlorine

A. E. Griffin, in his excellent paper, "Removal of Ammonia by Chlorination", presented before the Fifth Annual Water Conference of The Engineers' Society of Western Pennsylvania, Pittsburgh, Pa., showed that under normal conditions the feeding of chlorine to the extent of ten times the quantity of ammonia to be oxidized has been quite satisfactory. While the ratio of 10 to 1 does not hold for all cases, it sometimes may go as high as 20 or 25 to 1, the figure of 10 can be considered as the average.

It was pointed out in this paper that best results obtained at low temperatures, 45 F to 48 F are at pH values of 7 to 9, with retention periods of 2 hr, but with a retention period of 24 hr the pH range in which the chlorine dosage is very effective may be from 5 to 9 at this temperature.

It is quite obvious that for the destruction of relatively small quantities of ammonia, this method offers a very practical means as the residual chlorine can be determined by simple tests.

Should there be any objection to the residual chlorine, this can be reduced by the use of reducing agents such as tannin materials, sulphite, etc.

Where the makeup is being treated through a hot process softener the destruction of small quantities of ammonia is easily accomplished by substitution in part of chloride of lime for the lime requirements. Operating at a very high temperature, the reaction is very rapid, and in view of the fact that there is an hour's retention in the sedimentation tank when the softener is operated at rating, the conditions are favorable for the complete removal of ammonia.

L. P. Sudrabin[1], has reported that operating a hot process softener in this manner has removed the ammonia and has stopped the deleterious effects on condenser tubes that occurred in its presence.

[1]Discussion of A. E. Griffin's paper "Removal of Ammonia by Chlorination"—Fifth Annual Water Conference, The Engineers' Society of Western Pennsylvania. Oct. 30, 1944.

It is obvious, therefore, with the precipitation type softener, whether this be cold or hot, that the use of chlorinated lime provides for easy and direct means of ammonia destruction.

Mechanical Means

While it is commonly assumed on the part of many that a deaerator designed for the removal of oxygen and carbon dioxide, will be satisfactory for ammonia removal, this, however, is not the case. It is only necessary to make simple calculations with reference to partial pressure, etc., to illustrate that a deaerator will remove only a small portion of the ammonia, it cannot be expected to remove it entirely. Therefore, apparatus for removal of ammonia must be specially designed, taking into account the quantity of ammonia present, the residual tolerated, and the pressure of operation.

Figures 1 and 2 illustrate external and internal views of a Cochrane deammoniator, designed specifically to reduce ammonia from 5 ppm to 0.01 ppm, and this device has been very successful in making this reduction.

With reference to Fig. 2, the makeup water which has been previously zeolite softened and has a pH value of 10, enters the system at the preheater "B", which is an eight-pass heater, picking up the heat from the vapors within the heater, discharging the heated water through a spray pipe on a bank of cast-iron trays designed as "D". These trays are similar to those used in deaerating feedwater heaters, and the water cascades downward into the storage space, where its level is carried slightly below the upper U-tube. This water is in part evaporated by steam passing through the tubes of evaporator "E". This vapor then passes upward through the tray banks "D" and "C", is partially condensed in preheater "B", and further condenses in vent condenser. The final vapor comprising some

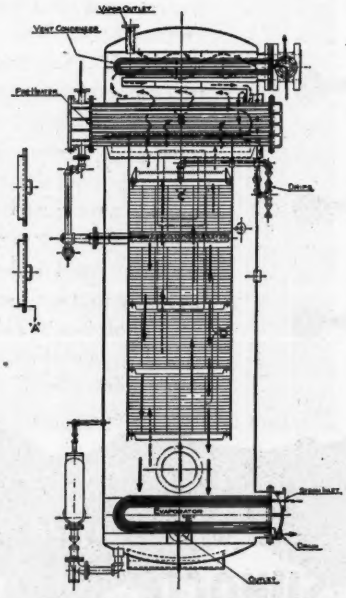

Fig. 2. Cross-sectional drawing of deammoniator

Tonnage that turned the tide

TUBE-TURN welding fittings weigh less—take only a fraction of the space. In the intricate piping systems of Victory ships, these savings increased tonnage capacity that helped turn the tide.

Weight-saving, space-saving, and low maintenance costs are important *in industry, too.* But they are only three of Tube Turns' many advantages over other fitting types. Tube-Turn welding fittings are easy to install. Their vibration-proof strength eliminates shut-downs for piping repairs. Their smooth inner surfaces insure maximum efficiency of flow. They permit greater flexibility of layout. Their greater strength means longer life for the entire system, increased safety at points of highest pressure . . . where direction of flow is changed.

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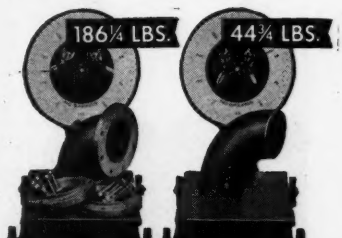


Less than 1/4 as much weight!
Actual weight of 8-inch cast iron flanged ell with flanges, bolts and nuts, 186¼ lbs. Actual weight of 8-inch Tube-Turn elbow to do the same job, 44¾ lbs.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*

steam and ammonia is discharged from the apparatus at the vapor outlet.

The vapors condensed in the vent condenser are drained and returned to the upper tray bank "C" through a loop and distributor, as indicated.

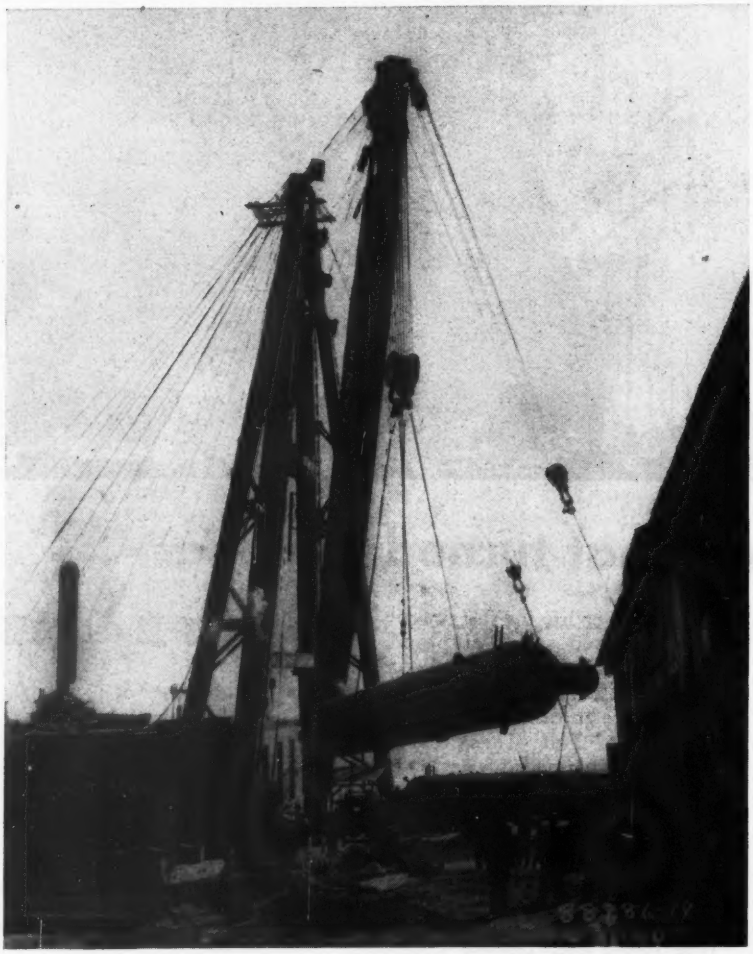
Because of the very high solubility of the ammonia, the water under treatment does not provide sufficient cooling or condensation of the vapor necessary to reduce the partial pressure to sufficiently low limits to obtain the results desired; therefore, the cooling water for the vent condenser is from an external source, and in this particular case is condensate.

This apparatus has been quite satisfactory in its operation and performance test indicated it has reduced the ammonia from 5 to 0.015 ppm at the full load rating.

A comparison of the internal arrangement of the deammoniator with the conventional deaerator indicates the difficulty of removing this gas and the inadequacy of the ordinary deaerator designed for oxygen and carbon dioxide removal.

Ion Exchangers

The use of ion exchangers regenerated with acid offers a very practical means of eliminating very large quantities of ammonia. In one plant where condensate from industrial evaporators is contaminated with 50 to 100 ppm ammonia, the ammonia has been reduced to zero by passage of condensate through an acid regenerated resinous type or ion exchanger. A pilot plant operating over 100 cycles has demonstrated the practicability of this type of apparatus. In addition this particular resinous ion exchanger under observation is giving satisfactory results at temperatures as high as 170 F, which is a definite advance in the use of ion exchange material, and may permit this method to be applied to the treatment of high temperature condensate without pre-cooling.



Hell Gate Boilers Under Construction

Erection of two immense steam generating units was started on November 9 with the unloading of two boiler drums each weighing 90 tons at the Hell Gate generating station of the Consolidated Edison Co. of New York. The boilers are the product of the Babcock & Wilcox Boiler Co. and the shipment from the Barberton, Ohio, factory required three 100-car trains. The drums shown in the illustration are 6 ft in inside diameter, 57 ft 2 in. long and are made of 70,000 lb ultimate tensile strength steel plate, 3 13/32 in. thick. They were floated 12 miles by barge from the railroad terminus. Each of the units being built is 142 ft in height, will cover a floor area of 3300 sq ft, is designed for continuous evaporative capacity of 900,000 lb of water per hr, with steam at a pressure of 1100 psi.

Contactors and Circuit Breakers as Switching Mechanism

(*Continued from Page* 87)

formers, and other accessories may be applied, meet the requirements of this type of application.

The necessity for having a switching mechanism in the control device which can be quickly and easily removed and replaced, is not nearly so great as it is in the case of a switching mechanism in a power generation or power distribution circuit. Therefore, the switching mechanism in a motor control equipment need not be easily replaceable, but it should be so located and so designed that it can be quickly, easily, and safely inspected and serviced in its normal position with a minimum of effort.

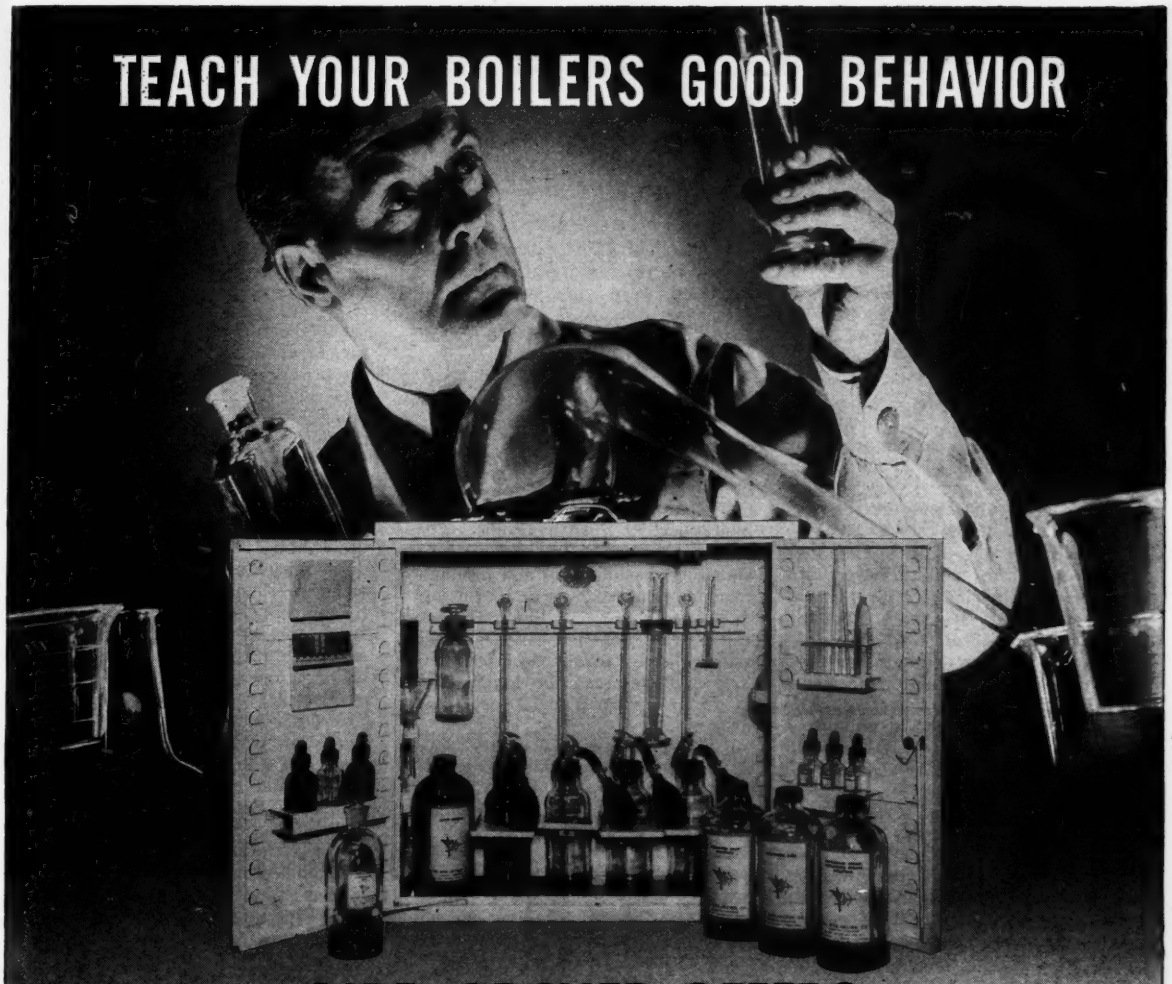
Time For Maintenance Work

The machines in industry driven by motors are generally incapable of operating 24 hr each day for long periods of time without maintenance. Even machines which operate continuously are usually shut down at regular periods for overhauling. Other machines are regularly shut down during a part of the day. In either case, when the machines are shut down, ample time is afforded for the maintenance of the motor and its control equipment.

It is recognized, of course, that there are always exceptions to general cases, and circuit breakers are used to advantage as switching mechanisms in motor circuits under certain conditions. This is especially true where large motors are involved and in locations where very large amounts of current must be handled under fault conditions, or where the service voltage is high (above 5 kv).

From consideration of the above factors the general conclusion is that circuit breakers, properly designed and properly built, are much superior for use as switching mechanisms in power generation and power distribution circuits, while properly designed and properly built contactors, adequately protected under emergency fault conditions are superior switching mechanisms for general use in motor control circuits.

TEACH YOUR BOILERS GOOD BEHAVIOR



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16th National Power Show Foreshadows Reconversion

AFTER TWO YEARS of starvation maintenance and deferred installation of needed equipment, 40,000 power and mechanical engineers crowded the aisles of the 16th National Exposition of Power and Mechanical Engineering at Madison Square Garden from November 27 to December 2, 1944, searching the booths of the 172 exhibitors for new equipment and ideas to aid them in keeping their worn-out plants running for the duration and in getting some idea of postwar possibilities.

There were only hints of the latter, for most of the exhibitors were still restricted to showing items not in violation of military security. Nevertheless a number of units developed for war production or military purposes were shown for prospective civilian use. Many other engineering items serve the same function in military as in civilian use, hence will be readily available as the military demand and necessity begins to decrease.

Steam Generating Equipment

In the field of steam and power generation, only a few items of steam prime mover equipment were on display; these did not adequately reflect the major trends in these fields. One complete "package" type steam generating unit was exhibited, consisting of a 4-pass, down-draft fire-tube boiler unit complete with oil-firing system, induced draft fan and all accessories. For natural draft installations, the same company also exhibited a working model of a self-adjusting damper, supported on ball bearings and automatically adjusted, by a system of vertically-acting weights, to maintain constant draft, thus providing a flow of combustion air in proportion to fuel feed and reducing stack losses due to excess air and infiltration. A complete small underfeed stoker, a pneumatic spreader type stoker, also a dumping-grate, forced-draft type spreader stoker, all of standard types, were the only other major boiler and firing units on display.

Piping and Valves

To demonstrate how flexibility and freedom from vibration could be secured in power piping systems, a display of functional pipe hangers and vibration eliminators showed a long section of 3-in. pipe arranged so it deflected several inches at regular intervals to show how the pipe hangers allow three-dimensional freedom of movement. An internal swivel action is incorporated in these hangers and they are designed with various spring factors for recommended design loadings up to 3800 lb.

One exhibit showed new percentage piston control valves in five sizes from ⅛-in. to ¾-in., designed for equal percentage flow characteristics, to produce a change in flow for a unit change in lift that is proportional to the quantity flowing just before the change.

Several exhibitors displayed valves, fittings and flexible tube and hose assemblies originally designed for production operations, some for refrigeration applications and there were displays featuring transmission of power hydraulically. Such hydraulic systems supply oil at from 1000 to 3000 psi for actuating machine tool and production machine elements by remote control.

A complete new line of thermostatic steam traps using a large heavy-wall helically-corrugated type of bellows and designed for high capacity at pressure from 0 to 220 psi, was on display.

Pumping Equipment

Among the exhibits of pumping equipment was a full-sized adjustable stroke vertical triplex phinger pump, as used for boiler feed and desuperheating service. In addition were several models of a new vertical triplex high-pressure pump, for hydraulic service, oil handling, pipe line service, die casting, hydraulic presses and the like. It is built for pressures up to 15,000 psi, capacities up to 228 gpm. It is designed with the fluid end at the top, so that the prime mover is connected near the floor, all parts are accessible, and the unit requires minimum floor space. The new porcelain pump plungers, designed to resist destructive effects of acidulous and gritty mine waters, oil, gasoline or liquid chemicals, were also displayed as used in these plunger type pumps.

An integral vacuum or pressure pump and motor assembly all in one casing consisted of a rotary vane type pump designed for supplying either pressure or vacuum, integrated with motor, exhaust air cleaner and automatic circulating visible oil system. Capacities are 1.4 to 35 cfm of free air, requiring ¼ to 2 hp when used as a vacuum pump and the same capacity ranges when used as a pressure blower for pressures from 3 to 30 lb.

A line of steam turbine, centrifugal pumps was shown for steam conditions ranging from 250 psi 450 F inlet to 5 psi exhaust, driving pumps of 200 gpm at 250-300 psi discharge pressure, up to units for 500 psi 700 F steam, 60 psi exhaust, driving pumps of 200 and 350 gpm capacity at 600 psi discharge pressure. Pumps are single-stage overhung impeller type, driven by an impulse type turbine with a single pressure stage and two velocity stages. Both pump and turbine rotors are mounted on a single shaft.

For improving plunger pump efficiency a cup type packing was displayed in which the pressure on the inside of the cup is alternately increased and released on forward and return strokes, to maintain close sidewall contact regardless of wear.

An operating model was shown of a combined motor and pump unit designed to fit right into the pipe line.

A corrosion resistant, totally enclosed, cowl-cooled squirrel-cage motor built in 2 to 15 hp capacity for 2 or 3-phase, 208, 220/440 or 550 v operation was shown in full operation in a water spray to demonstrate its protection against fumes and gases and dust, splashing and dripping liquids.

(*Continued on page* 146)

General view of 16th National Power Show at Madison Square Garden

FLAMENOL Showed No Aging

THIS FLAMENOL CABLE, after six years' exposure to weather, without covering, is as good as new. Note the glossy, uncracked surface.
THIS OIL-BASE, RUBBER-INSULATED cable, exposed to identical conditions over the same period, is dull and badly cracked.
THIS MINERAL-BASE, RUBBER-INSULATED cable, after the same exposure, shows the same dullness and cracking as the oil-base rubber insulation.

IN THIS SIX-YEAR TEST UNDER FLORIDA'S SUN

Back in 1937, a large railroad company operating in the South, where climate is particularly unkind to cable insulations, decided to test the stamina of various types of insulation. Two of the samples tested were the usual rubber-insulated types; the third was Flamenol. None was protected by braid or other covering, so that insulation was exposed directly to sun and weather.

In 1943, after six years of continuous exposure, the three samples were taken down, and examined. The dramatically conclusive results are shown in the photographs above. Only Flamenol had stayed young!

FLAMENOL RESISTS ACID, ALKALI, OIL, AND WATER

Before the war, millions of feet of Flamenol cable had already been installed in factories, oil refineries, mines and railroads; places where its ability to resist most solvents and heat made it a "must." In the future, this proved-performance cable will find even wider fields of application in reducing maintenance costs and minimizing shut-downs due to insulation failure.

Note, at the right, Flamenol's operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Company, Schenectady 5, N. Y.*

11 OUTSTANDING ADVANTAGES OF *FLAMENOL*

1. **FLAME RESISTANCE**—*will not support combustion.*
2. **CORROSION RESISTANCE**—*immune to action of oils, acids and alkalis.*
3. **SUPER-AGING**—*will not oxidize, therefore highly resistant to sunlight and weathering.*
4. **EXCELLENT PHYSICAL PROPERTIES**—*minimum tensile strength, 1,500 lb per sq in.; minimum elongation, 100 per cent.*
5. **CONSTANT DIELECTRIC STRENGTH**—*retained at about 720 volts per mil under severe operating conditions.*
6. **SMALL DIAMETER**—*saves space, and speeds wiring.*
7. **SMOOTH SURFACE**—*facilitates pulling through conduit.*
8. **VARIETY OF COLORS**—*simplifies circuit tracing.*
9. **FREE STRIPPING**—*steps up installation, avoids weakening nicks on conductors.*
10. **WIDE RANGE OF CONSTRUCTIONS**—*aids selection for special applications.*
11. **SELF-PROTECTING FINISH**—*eliminates need for braid covering, saves space and weight.*

Buy all the BONDS you can—and keep all you buy

FLAMENOL INSULATED CABLE

GENERAL ELECTRIC

502-47-1200

ASME Meeting

(*Continued from page 96*)

The laboratory work was conducted along two lines to determine:

1. The relationship between silica in the steam and silica in the boiler water at various pressures.

2. The relationship between solid silicic acid and the silica in the steam at various pressures and temperatures.

The power plant tests were conducted to find the following:

1. The relationship between the silica in the steam and silica in the boiler water.

2. The changes occurring in the silica in the steam as it passed through the turbines.

These tests indicate that the silica leaves the boiler as vaporized silicic acid which later crystalized on the blades in the lower pressure stages of the turbine. When the silica in the steam is below 0.1 ppm, no appreciable deposits are found in the turbines. Two methods of preventing deposits were suggested: (1) maintaining the silica in the boiler water below 5 ppm; (2) removing the silica from the steam by scrubbing with a pure grade water.

Graphitization

As one listened to the papers and discussions presented at the sessions on graphitization of steel piping, there was a definite feeling that important metallurgical history is taking place. Strangely enough, this phase of the study of graphitization started with the failure of a welded pipe joint in a power plant about two years ago after the piping had been in service for 5½ years at the prevailing high temperatures used in utility power plants, 925 to 950 F.

Prompt action was taken by the Edison Electric Institute and the Association of Edison Illuminating Companies to sponsor a research investigation project at Battelle Memorial Institute for the purpose of studying the fundamental causes of graphitization. Other objectives are to devise methods for curing graphitized joints, to prevent further graphitization, and to determine for new pipe what steels would best resist graphitization.

The extent of the existence of danger due to graphitization may be judged from a statement by Battelle to the effect that of 37 power stations reporting, representing approximately all of the high temperature plants, the weld samples gave no evidence of graphite in 21; in 11 stations, impairment of ductility was found to have set in; and in five stations, embrittlement of an advanced stage was found, and segregated graphite extended practically across the pipe section.

If graphitization has proceeded only to an intermediate state, it is thought that it should be possible to redissolve the graphite and restore the joint by heating to about 1700 F for 2 hr. In severe cases it has been necessary to cut out the old joint and reweld. A favorable postwelding treatment might be normalizing or stress relieving at 1300 F or above.

Investigations reported by H. J. Kerr and F. Eberle of Babcock & Wilcox Co. show that steels which displayed in the McQuaid-Ehn tests a totally normal case with a grain size of 1 to 5, did not graphitize, though in the case of castings some have and some have not.

On the basis of their studies, Kerr and Eberle make the recommendation that coarse-grained normal carbon-molybdenum steel with an addition of 0.4 to 0.6 per cent chromium be used for high-temperature steam plant application because of the greater stability of the carbide phase in these normal steels as compared to similar steels showing abnormality on the McQuaid-Ehn test.

Authorities seem to be agreed that deoxidation of the steel by aluminum, used in its manufacture, has a definite accelerating effect on the formation of graphite. It is reported that at least 2 lb of aluminum per ton is used for certain types of steel to produce the necessary soundness. Carrying out the idea that aluminum deoxidation definitely promotes graphitization, it has been proposed to limit the aluminum addition to ½ lb per ton, and work already under way suggests that reasonably good practice is possible with this lower amount of aluminum.

I. A. Rohrig of the Detroit Edison Co. reported that his investigations indicate that austenitic chromium nickel filler metal readily absorbs carbon and that this characteristic results in the removal of carbon from the heat-affected area of the pipe metal. Further, it is strongly indicated that such filler metal will inhibit the formation of dangerous chain type graphitization in the critical zone during high temperature service.

The investigations have not been completed but the research work is well under way and it will probably not be long before definite specifications will be drawn up for high temperature piping steels and welding methods.

Instruments

To the power engineer, the paper of greatest interest dealing with instruments was that delivered by R. E. Sprenkle of the Bailey Meter Co. The author dealt with piping arrangements for the flow meters, stressing accuracy of measurement. He stated that most of the recommendations given in published literature are based upon standards of piping requirements established by the Joint AGA-ASME Committee on Orifice Coefficients. These standards as well as others obtained since that report was published in 1937 were shown in the form of seven schedules covering the use of orifices and flow nozzles, and an eighth schedule applying to Venturi tubes only. "These schedules," the author states, "serve as a basis for developing typical piping layouts which are designed to interpret and clarify the principles involved from a practical application standpoint."

Regarding the choice between two different head meters or between an orifice or a flow nozzle, it was stated that the ultimate decision in most cases will depend upon the cost involved. In general, the higher the meter differential the higher the cost. Flow nozzles are more expensive than thin-plate orifices.

Among the newly developed instruments now being used is one described by Paul G. Exline of Gulf Research & Development Co. for measuring the piston ring pressure in internal combustion engines. The instrument works on the pneumatic principle and is used in the work being done to improve the performance of piston rings which involved the determination of the optimum pressure which should exist between the piston ring and the cylinder wall.

Another new device, developed by Westinghouse and described at this meeting, is the mechanical transients analyzer, for solving transient vibration problems by the principle of electrical-mechanical analogy. The use of the device was illustrated for several types of problems, including the ridability of vehicles, and the shaft torques developed in turbogenerators by electrical short circuits.

Heat Transfer

Seven sessions were devoted to the discussion of heat transfer subjects, the papers presented were, in nearly all cases, the descriptions of research work carried on by manufacturers of heat exchange equipment and university laboratories on specific types of heat transfer surfaces and arrangements for the purpose of developing mathematical means for calculating surface requirements.

One session was conducted as a symposium on methods of measurement of heat absorption in both boiler and industrial furnaces. It is interesting to note the various methods by which different engineers attack the problem of determining the amount of heat transfer in boiler furnaces. One authority obtains the over-all heat absorption of a furnace by measurement of gas weight and temperatures at furnace outlet. Another uses measured metal temperatures and temperature gradients of the tube wall to determine the rate of transmission of heat to the fluid. Still another evaluates tubular heat receiving surfaces located in or forming furnace walls in terms of plane surfaces, which involves the determination of the distribution curve on the half perimeter facing the source of heat.

Other sessions of the meeting of interest to power engineers dealt with lubrication, air conditioning, metals and wood industries, most of which were of a highly specialized and technical nature evidently intended to interest designers rather than operators of power equipment. Research seems to be the order of the day among engineers throughout the country and many excellent papers presenting descriptions of procedures, equipment used, experimental data gathered, mathematical proofs, and detailed analysis of results were discussed during the meeting, all of which lead to the conclusion that the engineering profession is still young with many scientific principles and their uses still to be developed.

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WATER TREATMENT AND ENGINEERING SERVICE

Capacitors Save Critical Fuel and Copper

By E. N. BOWLES
Apparatus Specialist
Westinghouse Electric & Mfg. Co.
Milwaukee, Wis.

IN "MAKING THE MOST OF WHAT WE HAVE," capacitors for power-factor correction of electric circuits have played an important part. They have enabled war-production plants to rapidly increase the capacity of existing facilities with the minimum use of critical materials. A typical example is the capacitor installation at the Tractor Works of J. I. Case Co., Racine, Wis.

Immediately after Pearl Harbor, it was evident that the Case Co. would do its part for war production, so a survey of all plants was made to determine the maximum each could produce. The Tractor Works survey showed that the electric power capacity would have to be increased. After careful study, this was accomplished by: (1) Changing a non-condensing turbine to make it suitable for condensing operation; (2) Installing a new steam boiler of capacity to meet the planned increased demand; and (3) Raising power factor, so that generators and 2400 v feeders to plant sub-stations could replace wattless currents with the increased useful power current. Before the improvements, the maximum plant load had reached 2600 kw, and that was all the boiler could handle. The electric generators had a capacity of 4000 kva, but due to a low plant power factor of 70 per cent, they could only deliver 2800 kw. However, since the above improvements were made, the power plant is able to handle the wartime demand of 3800 kw.

Power factor correction is a means of increasing capacity of equipment so the above is by no means unique. But, in addition to a small saving in fuel due to the reduced I^2R losses, the Case Co. has been able to make a substantial fuel saving due to operating economies. The generating equipment consists of one 2500 kva and two 750 kva turbine-generators. The large machine has a steam rate of 12¾ lb per kw but the two smaller machines being older, take 23 lb per kw. Until the recent increase, the average load was 2300 kw, and at 70 per cent power factor they had to run a 750 kva generator as well as the larger one. With a 95 per cent power factor, the 2500 kva unit now carries up to 2700 kw and the company reports, "The fuel thus saved has paid for the capacitors."

The original feeders still serve the transformer sub-stations, but if the feeder power factor had not been raised, the increased loads would have necessitated installing some 12,000 ft of the 250,000 cm cables. At maximum load, the power factor is now 95 per cent at the generating station.

Two 360 kva capacitor racks are installed in the generating station, and at transformer substations there are four 120 kva and one 180 kva racks. Two of the substation units are outdoor installations. There are also 4 kva single phase units mounted outside. These units are sectionalized with 10 kva and 5 kva terminals, so they are balanced on the three-phase 2400 v lines. Each rack consists of hermetically solder-sealed and Inerteen filled units with boric acid

(*Continued on page* 150)

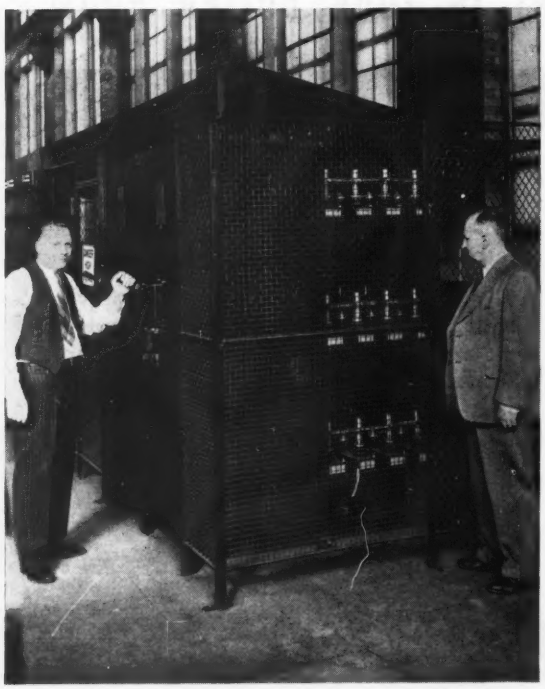


Fig. 1. Two 360 kva capacitors installed in the main generating station of the tractor works of the J. I. Case Co.

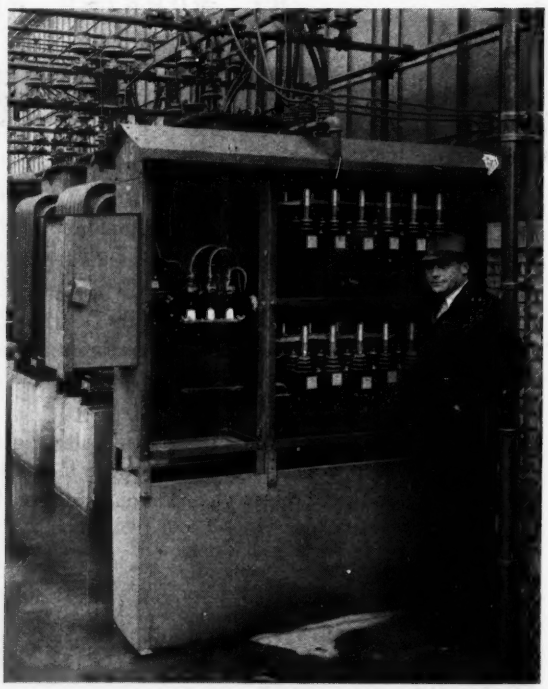
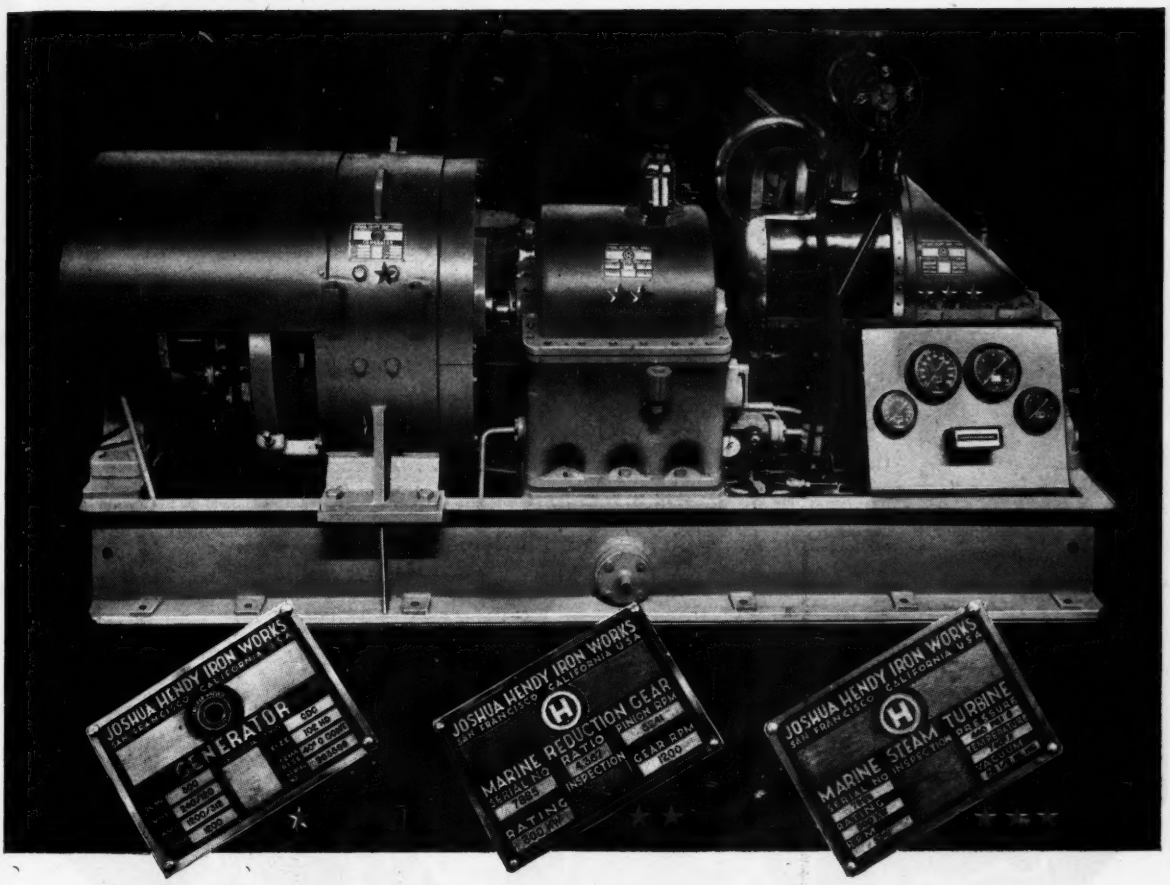


Fig. 2. One 180 kva capacitor installed in the outdoor sub-station of Wing Building. The cover has been removed



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The all-steel turbine allows unusual accessibility and is precision-constructed to assure excellent operating characteristics.

The reduction gear, smooth and clean like the turbine, has its bull gear and pinion mounted in precision-type babbitt-lined bearings to guarantee quiet operation over long periods.

The conservatively rated generator, either a-c or d-c, assures smooth operation because of the unusually close dynamic balance of the armature.

Together, these three matched Hendy-built units form a turbo-generator set completely designed by experienced Hendy engineers, in a range of 250 to 750-kw, to give you the utmost in service for a wide variety of marine or industrial applications.

For complete data write for new catalog on Hendy Type HG-26 Auxiliary Turbo-Generator sets.

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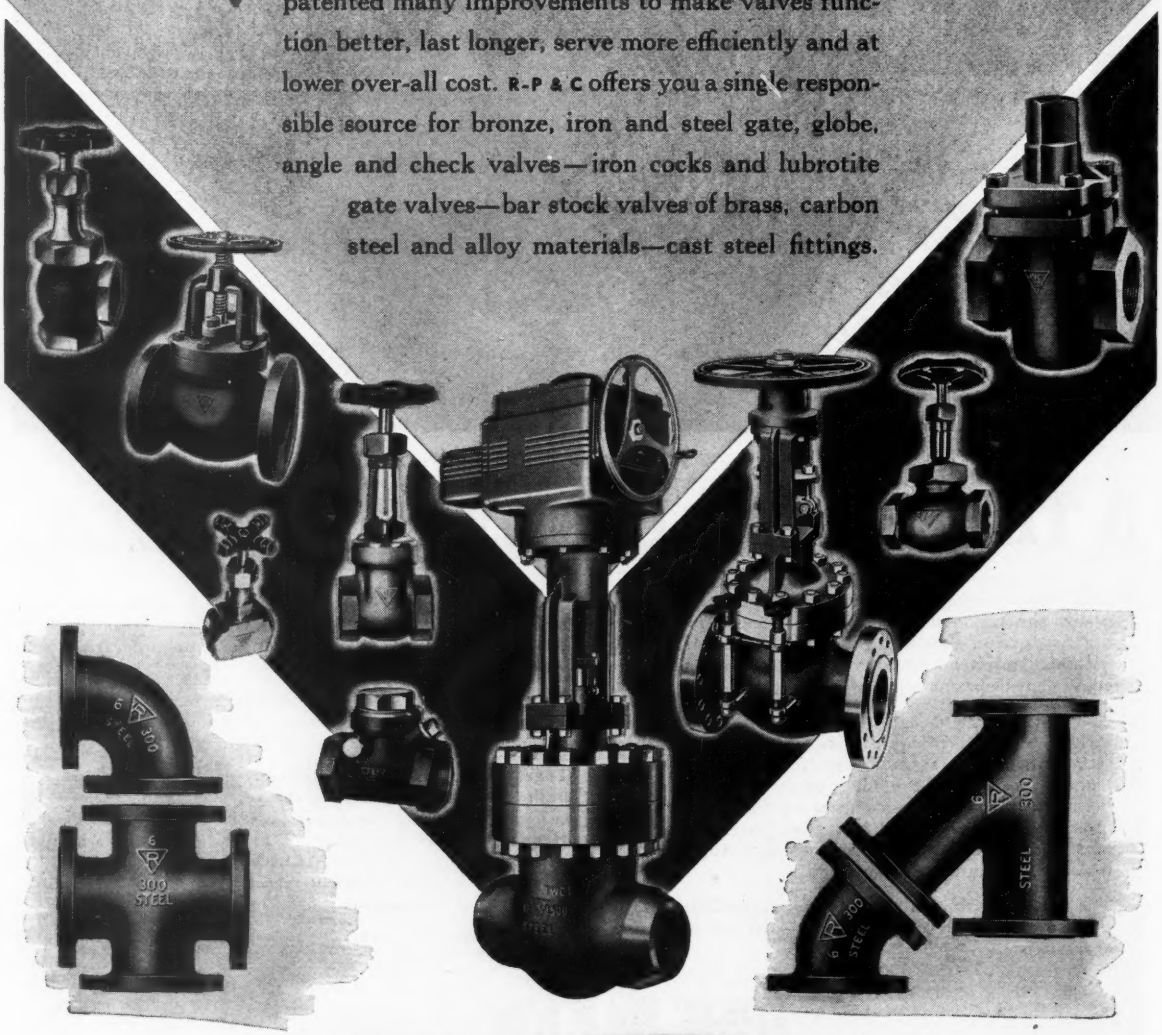

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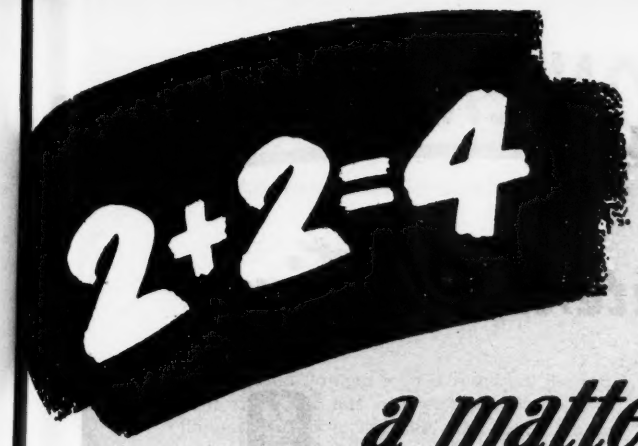

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IT'S A FACT that Shell Turbo Oil was the first of its type to be approved as meeting stringent U.S. Navy specifications 14-0-15 (INT) . . . that millions of gallons are being used yearly by the Navy in turbine service far more rugged than the operating conditions to be found on land.

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IT'S A FACT that, although the Rust Test for turbine oils, sponsored by Shell, has been tentatively accepted as a standard by the A.S.T.M., there is no standard test for determining the performance characteristics of a turbine oil in service.

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IT'S A FACT that Shell is the first and only oil company to design a procedure as well as an oil especially for the cleaning of turbine oil circulating systems, a phase of turbine operation that is being recognized by turbine operators as a necessity to efficient, modern turbine maintenance.

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IT'S A FACT that, in the ceaseless search to obtain as perfect a turbine oil as possible, Shell developed the "Film Tenacity" test which shows Shell Turbo Oil outstanding in resisting the constant washing effects of water.

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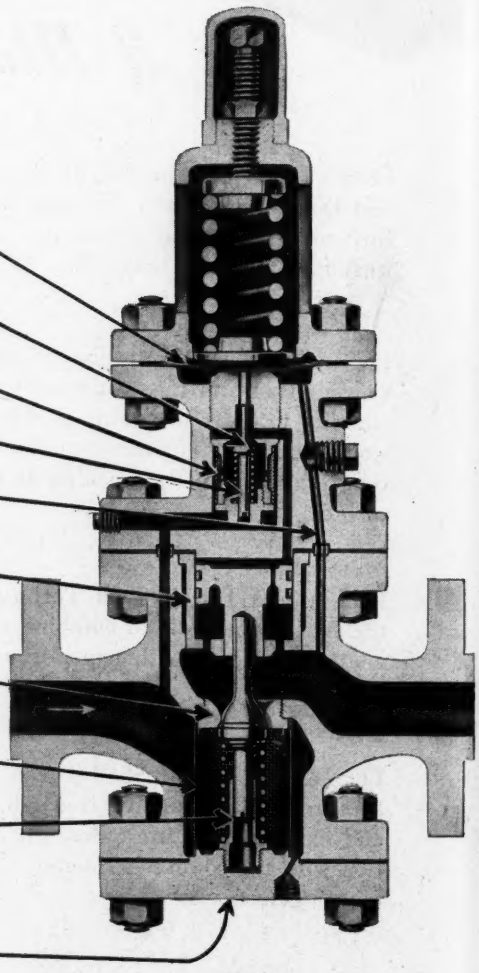

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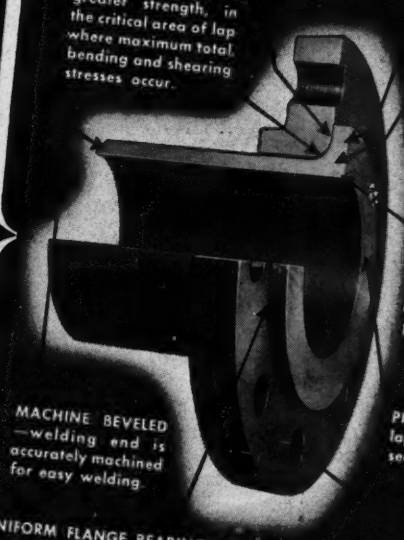
Specify **MIDWEST FOR THESE REASONS**



FORGED LAP—by special Midwest process that simultaneously upsets pipe and forms lap. Tests prove superiority of process.

LARGE RADIUS FILLET—More metal, hence greater strength, in the critical area of lap where maximum total bending and shearing stresses occur.

HEAVY LAP—After machining front and back, lap is always at least equal to pipe wall thickness.

STRESS RELIEVED—Metal in lap is worked at forging heat, then normalized to assure uniform, close grained structure. Photo-micrographs frequently show it to be superior to original pipe metal.

SQUARE CORNER—(instead of a round corner) adds to lap strength and eliminates pockets for accumulation of condensate and sediment which promote corrosion.

MACHINE BEVELED—welding end is accurately machined for easy welding.

PHONOGRAPHIC FINISH—of lap face to hold gasket more securely.

UNIFORM FLANGE BEARING—Back face of lap carefully machined to assure uniform flange bearing necessary to satisfactory joint.

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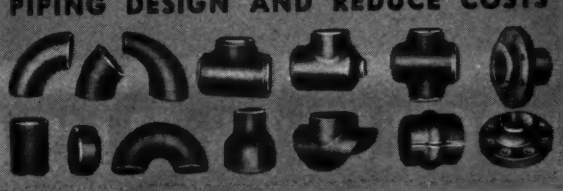
Sales Offices: New York 7—(Eastern Division) 30 Church St., Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



Yes, Men Make Motors!

NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

No machine can do that job — and no machine can fully test how well it is done.

There's only one test . . . wait 5, 10, 15 years and *see.*

And that's the test in which Allis-Chalmers motors have proved over the years that they're *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

• • •

YES, HUNDREDS of Allis-Chalmers men—craftsmen like Sam Meister — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a *friend* . . . and they know that's something no company and its workers can have too many of.

Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 1730

A-C VICTORY PEACE

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

When you need *Pipe Outlets* —use WeldOlets

WeldOlets are available in three types—Welding Outlet, Threaded Outlet, and Socket Outlet.

Check these WeldOlet features which insure easy, economical and efficient branch pipe jobs.

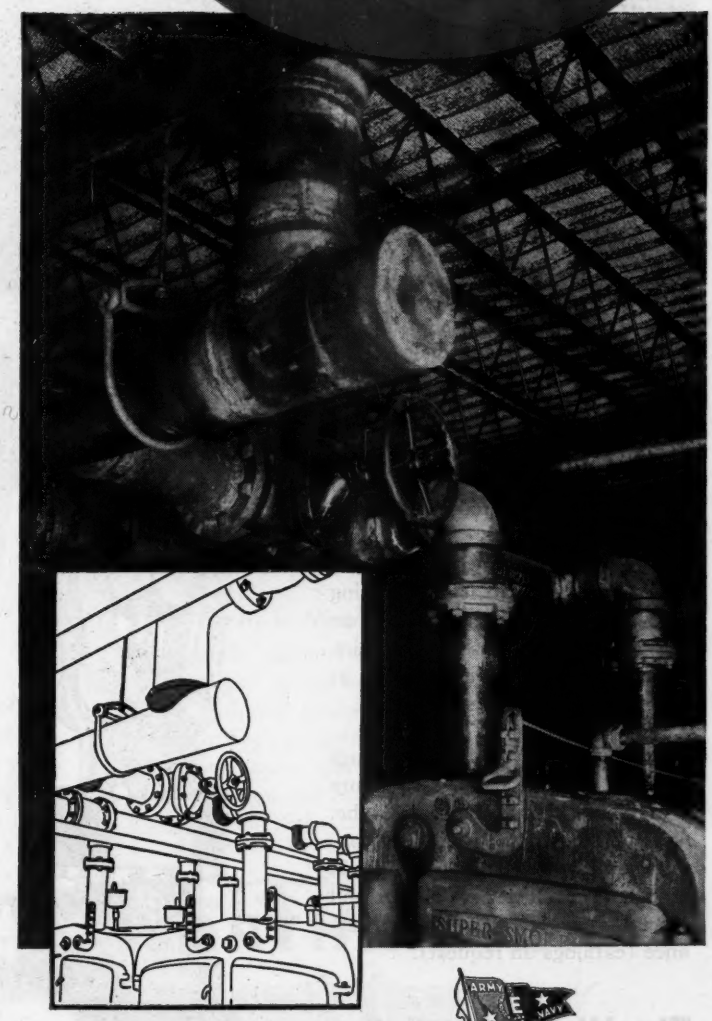
No need to cut out section of main line. Fitting is used as template, hole cut, fitting tacked and welded to pipe. The inside can then be inspected before branch is connected.

Construction of drop-forged WeldOlets restores original strength to main pipe. The heavy reinforcing rib section of fitting compensates for loss of strength in the main pipe when the hole is cut.

Free, unrestricted flow is assured because turbulence and friction are reduced to a minimum by the funnel-shaped design of the inlet of the WeldOlet.

WeldOlets are made in size-to-size and reducing sizes for standard pipe sizes up to 24" and for pressures up to 400 lbs. at 750° F.

Our illustrated catalog containing complete application and installation information will be sent to you on request.



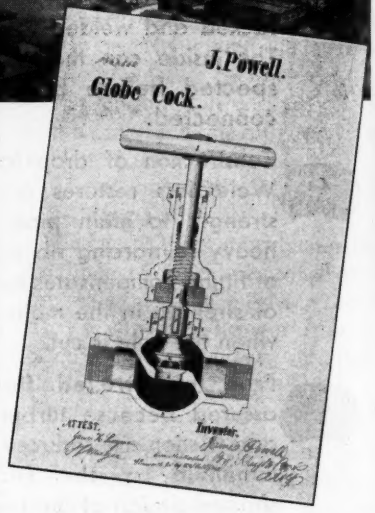
Forged Fittings Division · BONNEY FORGE & TOOL WORKS · *639 N. Meadow St., Allentown, Pa.*

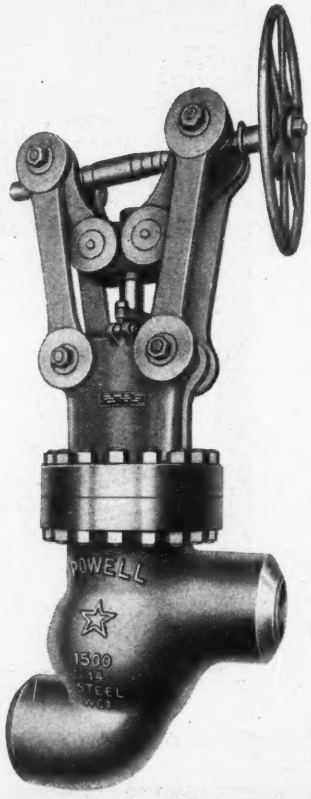
WELDOLETS
TRADE MARK REG. U. S. PAT. OFF.
PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets

99 Years of Leadership *in making valves for industry*

In a book on Cincinnati, published shortly after the Civil War, the following statement concerning the Wm. Powell Co. appears—"the Company, founded in 1846, manufactures the celebrated "Star" Regrinding Globe Valve, now in use in all parts of the country." Shown at the extreme right is the drawing used in 1865 to get the patent on this valve. The plant in which these valves were being made at that time is shown in the inset.

Today, in modern plant buildings covering many acres, the company is making a complete line of Globe, Angle, Gate, Check, Relief, Y, Non-return and other types of valves in bronze, iron, steel, pure metals and special alloys for corrosion resistance (catalogs on request).





Through the years Powell Engineering has not only kept pace with, but has actually anticipated the flow control requirements of the vast power field. When the trend toward higher pressures and temperatures became evident, Powell was ready with the answer—a complete line of Cast Steel Valves—Globe, Angle, Gate, Y, Check, Non-return, etc., Hand, Gear and Motor operated—capable of handling every working pressure from 150 up to 2500 pounds and temperatures as high as 1400 F. Catalogs and detailed information will be gladly furnished on request.

The class 1500-pound, 14" welding end, toggle operated, Cast Steel Non-return Angle Valve shown here was designed to meet certain specific requirements. If *you* have any individual problems in flow control, Powell Engineering will gladly help you solve them.

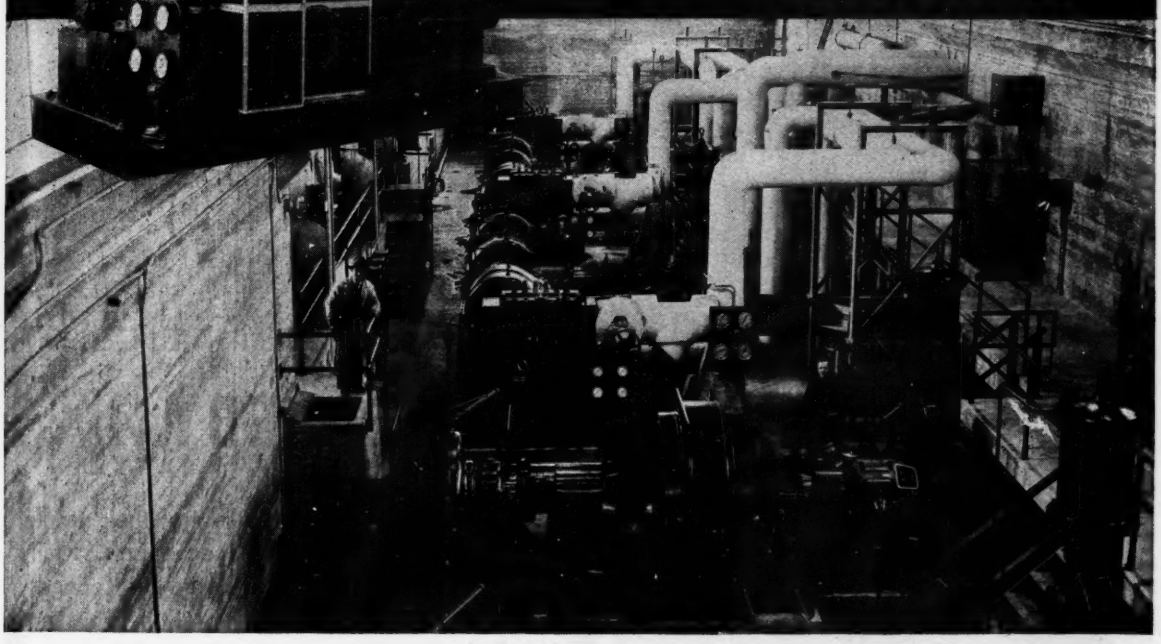
The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

POWELL VALVES

BACK PRESSURES UP
...160 POUNDS
...220 POUNDS!



Result: Lowest power costs at new synthetic rubber plant with Worthington-Moore turbines

In Canada's new government-owned synthetic rubber plant, operated by Polymer Corporation, Ltd., Worthington-Moore high back pressure steam turbines have permitted considerable savings in power costs. In this, Canada's largest steam plant installation, engineered by H. G. Aeres and Company, power is produced as a by-product, since all exhaust steam is used for plant operation.

Three Worthington-Moore 1650-hp. geared multi-stage turbines are illustrated above as installed. These topping turbines operate with steam at 400 lbs. initial pressure, 650°F. temperature, and exhaust against 160 lbs. back pressure. Two 1000-hp. Worthington-Moore turbines, exhausting to 220 lbs. back pressure, were also selected.

Save Money in Modernizing Steam Plants

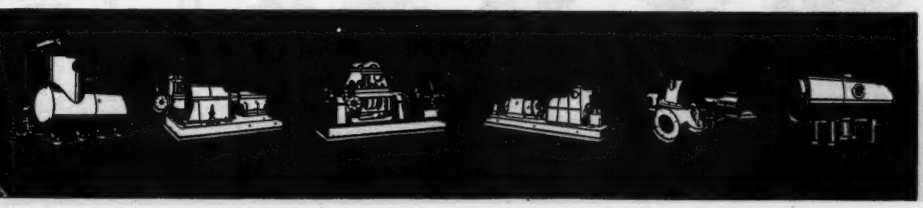
Worthington-Moore turbines operating against unusually high back pressures have enabled many plants to install modern high-pressure boilers without scrapping existing low-pressure apparatus. Write for complete details. *Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, New York.*

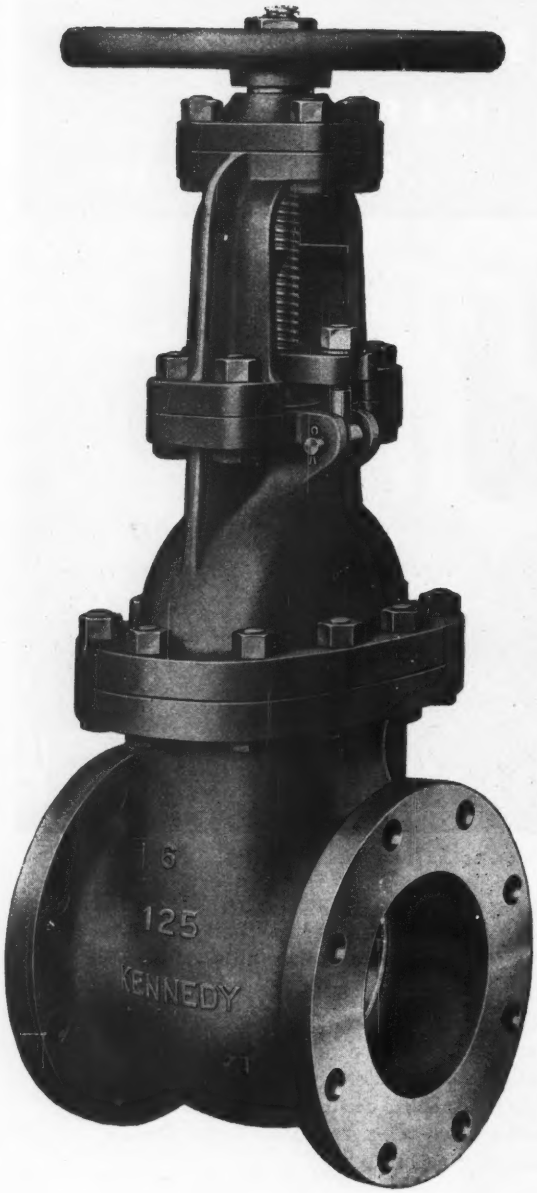
WORTHINGTON *BEHIND THE NAME*

MOORE

MR4-7

A GREAT TEAM IN STEAM





- **RELIABILITY**
- **STRENGTH**
- **ECONOMY**
- **SAFETY**

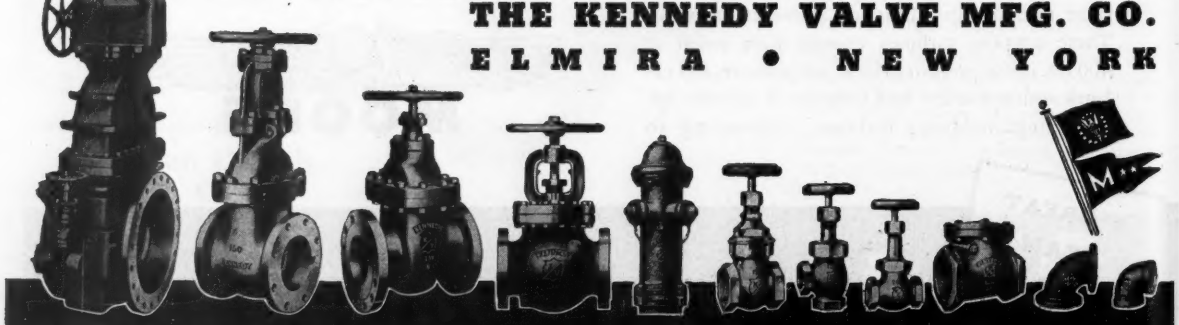
. . . characteristics of every **KENNEDY** *valve*

Kennedy Valves are reliable because of their simple, sturdy and effective operating mechanisms. Many of these mechanisms were originated by Kennedy, and have proven their effectiveness in thousands of installations.

These valves are economical because of their durability which has been demonstrated by decades of service in many installations without maintenance expense.

Their generous proportions of all parts, together with high-quality, high-tensile-strength metal, assure ample strength and complete safety. You are always safe with Kennedy "Extra Value" Valves.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK



KENNEDY *valves . . . pipe fittings . . . fire hydrants*

NEW MOVIE EXPLAINS THE

Gas Turbine

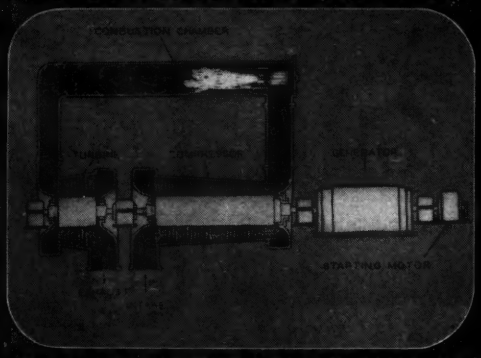
Now—for the first time in simple, everyday terms—Businessmen and Engineers can get the complete history, development and operation theory of the Gas Turbine in Allis-Chalmers new, sound motion picture, "Tornado in a Box".

ALLIS-CHALMERS
MILWAUKEE

♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve.*

HERE ARE SCENES FROM A-C'S NEW MOVIE "TORNADO IN A BOX"

"Air inside the humidor expands after heat from the blow-torch increases its pressure. Then we can put it to work."



"Here are the prime elements of every gas turbine cycle — starting motor, compressor, combustion chamber and turbine."

"Let's see how the cycle works in terms of temperature. This represents temperature, and here is the entropy scale."

16 MM. PRINTS FREE

Film runs 28 minutes. 16 mm. prints available for loan — to be used on sound projectors only. Fill in and mail coupon to Allis-Chalmers, Milwaukee 1, Wis.

Name.....

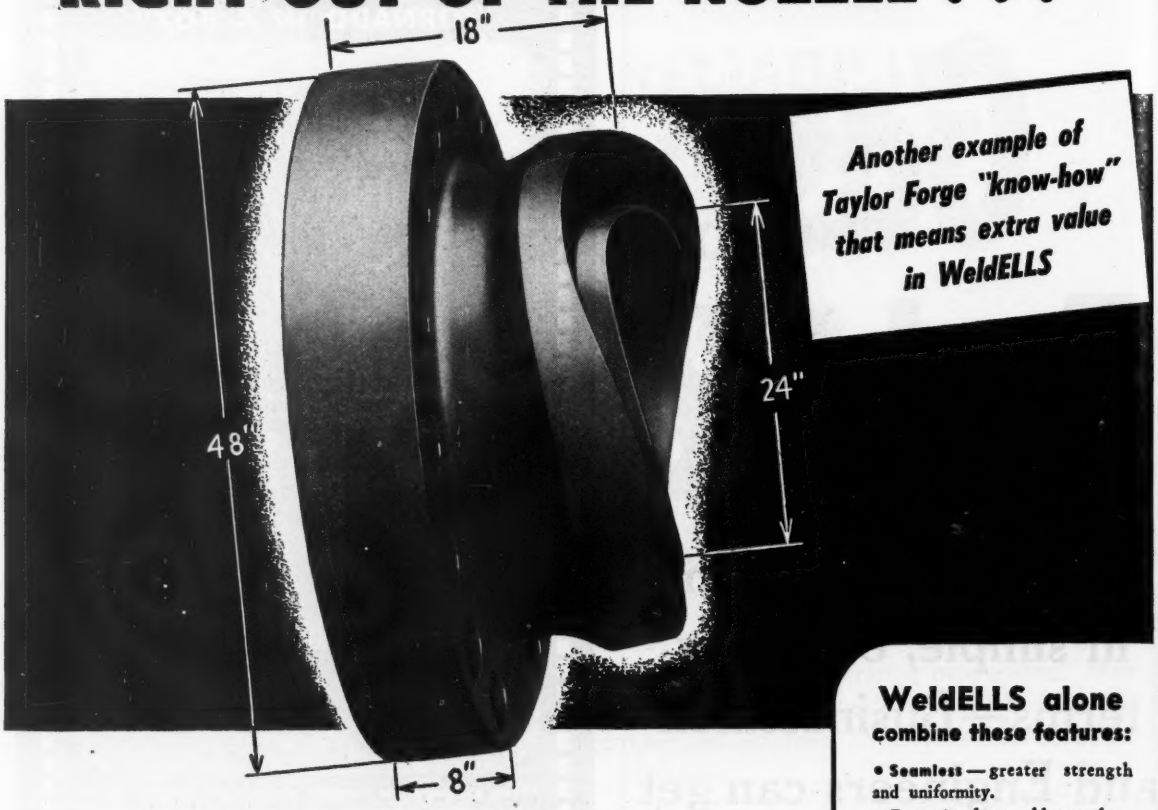
Firm.....

Street.....

City.....State.....

2 A 1817

RIGHT OUT OF THE NOZZLE . . .



Another example of Taylor Forge "know-how" that means extra value in WeldELLS

★ *Walk into any big, modern oil refinery or power plant and the chances are you will find Taylor Forge nozzles like the one pictured above providing safe, full strength outlets on high pressure boilers and pressure vessels. This is no coincidence. As America's first maker of fully reinforced pressure vessel outlets, Taylor Forge has built up a fund of technical information on the complicated subject of stress conditions in such vessels, and engineers have learned to draw heavily upon our experience and knowledge in designing for full strength.*

NOZZLES like the above bring the steam or other fluid out of the boiler or pressure vessel, but from there on the job is taken over by the piping system. And here, too, Taylor Forge "know-how" and experience play an important part. For this knowledge has resulted in a very nearly ideal line of Welding Fittings.

Yes, WeldELLS and other Taylor Forge Welding Fittings are *designed* for the job they are to do . . . designed to provide safe, long lived and economical piping.

Just take a moment, please, and check the list of features opposite. Are there any you would omit? Can you think of any you would add?

That's why we say WeldELLS are very nearly ideal—why you can be sure that

WeldELLS *have everything*

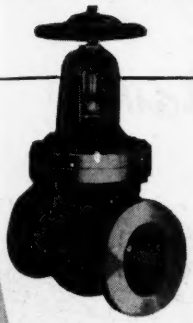
WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

4 Automatic Control Valves

Helping Conserve STEAM and WATER for VICTORY

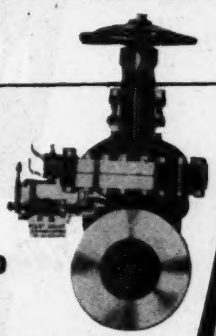


NON-RETURN

NON-RETURN—Golden-Anderson Triple Acting Non-Return Valves are insurance to life and property. They operate both ways, automatically shutting down steam flow from boilers in case of bursting line—and—preventing reverse flow into an injured boiler. Automatic testing feature permits testing of automatic feature at any time, or closing from remote point.

★ ★ ★

ALTITUDE CONTROL—Automatic, air and water cushioned. These Valves will hold water in elevated storage at exact predetermined level. No floats, long connections or complicated fixtures needed. Operation is by static head. Places control in accessible position, and is unfailing in operation.



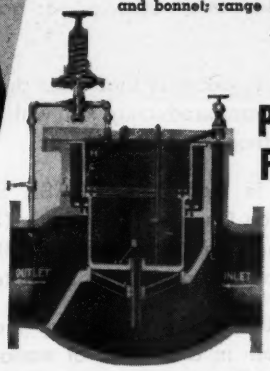
THROTTLE AND ENGINE STOP

THROTTLE AND ENGINE STOP—Instantly shuts off steam when engine or turbine overspeeds. Eliminates burst fly wheels and wrecked turbines, with attendant cost and danger to life. May be used as a throttle valve without interfering with safety feature, as it will close on tripping from any position.

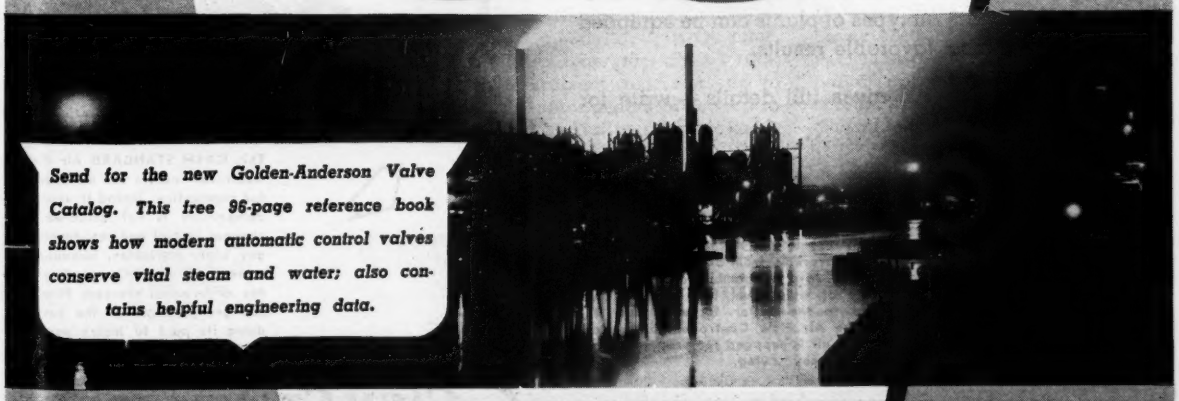
★ ★ ★

PRESSURE REDUCING — Particularly adaptable for intermittent or dead-end service, the G-A Steam Pressure Reducing Valve insures uniform terminal pressure on varying capacities. . . . It is furnished in sizes from 2½ in. to 12 in., made of Double Extra Heavy cast iron, with a semi-steel or cast steel body and bonnet; range 125 to 400 lb.

ALTITUDE CONTROL



PRESSURE REDUCING



Send for the new Golden-Anderson Valve Catalog. This free 96-page reference book shows how modern automatic control valves conserve vital steam and water; also contains helpful engineering data.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

Fulton Building, Pittsburgh, Pa.

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

Work Continuously in your Favor

MORE STEAM

LESS FUEL

MAINTENANCE SAVINGS

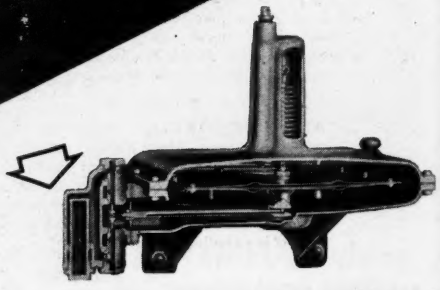
if your boiler is not receiving constant automatic attention the chances are that you are not getting all of the steam possible from the fuel used—coal, oil, or gas. In short, you have fuel waste.

The big point to think about is that your present boiler can do a bigger steam producing job with savings in fuel and greatly reduced attention needs.

The simple reason is that with a CASH STANDARD Automatic Combustion Control System you (1) maintain a constant draft in the combustion chamber (2) you meter the air needed for combustion (3) you regulate fuel feed.

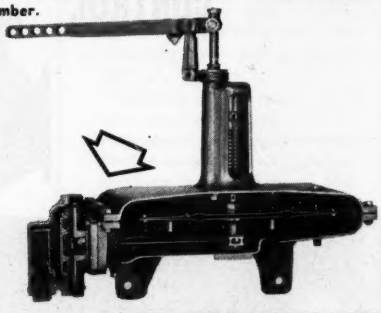
CASH STANDARD Units, which make up the systems, are available in a number of variations so that all types of plants can be equipped for the most favorable results.

Bulletin No. 300 gives full details — write for a copy.



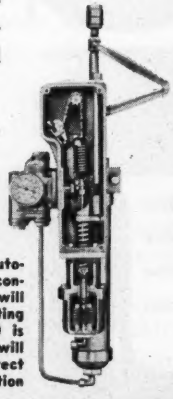
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

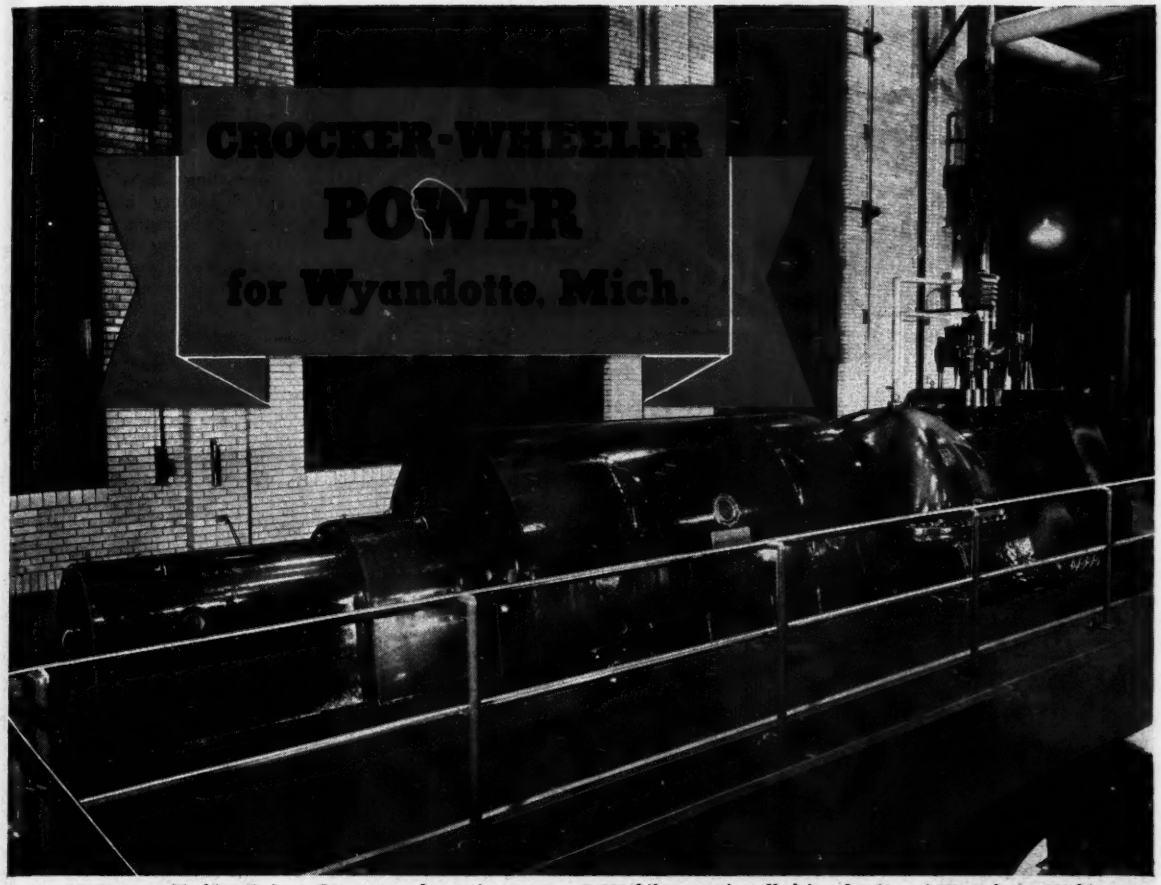


FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES



DEPENDIPOWER Turbine Driven Generator, alternating current, 7,500 kilowatts, installed for the City of Wyandotte, Michigan.

THE GROWING, heavily war-producing city of Wyandotte, in the Detroit area, is faced with continuously increasing demands upon its public power service.

Wyandotte is one more of the many busy American cities proving the dependability of Crocker-Wheeler Generators... for power delivery under all conditions, with low maintenance costs and cleanliness in operation.

Crocker-Wheeler Motors are also demonstrating the advantages of their liberal design, for heavy duty in thousands and thousands of war-busy plants.

Before you add equipment, let Crocker-Wheeler make recommendations for your specific needs.

Crocker-Wheeler makes a comprehensive line of electrical equipment for power plant and factory — polyphase induction motors from ¼ to 10,000 horsepower; direct current motors from ½ to 5,000 horsepower; alternating current generators up to 10,000 kva.; direct current generators up to 7,500 kva.; motor-generator sets up to 7,500 kilowatts; resilient flexible couplings for shaft diameters up to 5 inches.

• • •

Crocker-Wheeler, one of the leading companies in the field, specializes SOLELY in the design, manufacture and application of electric power equipment.

As power SPECIALISTS, Crocker-Wheeler field engineers know the power needs of your industry—of your particular production processes. Call in one of our experienced engineers for specific advice on motors, generators, control and couplings... no obligation.

CROCKER WHEELER Motors Generators

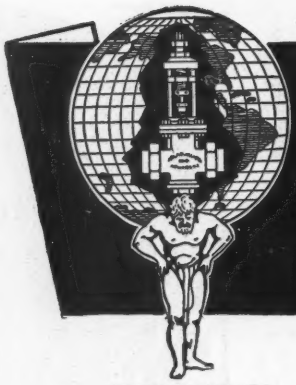
JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

ESTABLISHED 1856

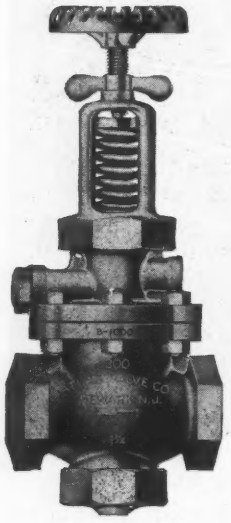
AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON • LOS ANGELES



ATLAS "Type B" STEAM REDUCING VALVES

TRADE MARK REG.



for services demanding tight seating and uniform reduced pressure

Control diaphragm and controlled pressure port are integral with the valve body. The main valve is caused to open wide and close tight with slight changes in the reduced pressure through the operation of the pilot. Wide fluctuations in initial pressure have practically no effect on the reduced pressure because of the pilot operation. Renewable piston chamber, internal pilot valve, and main valve strainers. Main valve disc seats tight because disc stem is guided by center bearing cast integral with seat ring.

ATLAS Type "B" Valves are simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm cap and unscrewing pilot valve seat.

For 300 lb. Service, All Bronze

Screwed or Flanged Ends—Bronze or Nickel Alloy Seats and Valves—Pilot Operated. For initial working pressures from 25 to 300 lb. saturated steam; for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: ½", ¾", 1", 1¼", 1½", 2".

For 250 lb. Service, Iron Body

Flanged Ends—Bronze or Nickel Alloy Seats and Valves—Pilot Operated. For initial working pressures from 20 to 250 lb. saturated steam; for reduced working pressures from 1 lb. to within 20 lb. of initial pressure in one stage. Sizes: 2½", 3", 4", 5", 6", 8".

For 400 and 600 lb. with Temperatures to 900° F., Steel Body

Series 40 for steam service to 400 lb.
Series 60 for steam service to 600 lb.

Monel Metal, Stainless Steel and Nitralloy Seats —Stainless Steel Piston and Piston Chamber—Flanged Ends—Pilot Operated. For reduced working pressures from 1 lb. to within 30 lb. of initial pressure in one stage. Designed and built to withstand severe corrosion and wearing service under high pressure and temperature conditions. Sizes: ½", ¾", 1", 1¼", 1½", 2", 3", 4", 6".

Write for Bulletin No. 1A giving complete details.

OTHER ATLAS PRODUCTS:

Check this list and mail to us with your name, firm name and address.

- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Exhaust Control Systems
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Pump Governors
- ☐ Pressure Regulators
- ☐ Float Valves
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

Specialists in Regulation for Nearly a Half Century
291 South St., Newark 5, N. J.
Representatives in Principal Cities

16th National Power Show

(*Continued from page* 126)

Another new protected polyphase squirrel-cage motor with protected frame, sealed ball bearings, copper spun rotor and cross-flow ventilation was also shown.

An interesting array of rupture diaphrams or safety heads for relieving excess pressure in pressure vessels and thus preventing explosions showed their use in conjunction with safety valves on compressed air and refrigerating systems, chemical and oil vessels, storage tanks, Diesel crankcases, fire-extinguishing systems and the like.

For one-man handling of standard 55-gal steel drums quickly and without injury to drum or strain on workmen, a new barrel-lift with locking devices and adjustable leverage features was shown.

Oil, Air and Metal Cleaning

Clean oil and clean air are two of the most important substances used in industry today. To produce the former, a new cartridge type oil purifier was displayed. This employs multiple cartridges to permit a high flow rate and the individual cartridges are easy to handle.

For air cleaning, one display of heavy duty oil bath and industrial air filters showed their construction and application to air compressors, oil, gas and gasoline engines, generators, hydraulic presses and blowers. In the oil type, the air and filter elements are washed automatically by the action of the oil, which is renewed periodically. In the air-type filter, baffles are used.

For cleaning of metal surfaces and small metal parts, compressed air sprayers for spraying solvents, cleaners and paint stripping solutions were shown. These were especially recommended for cleaning coatings of grease and oil from gasoline and Diesel motors and other types of machinery. Ready to use degreasing compounds, to be mixed with kerosene, are available to loosen and cut grease from metals, glass, concrete and tile.

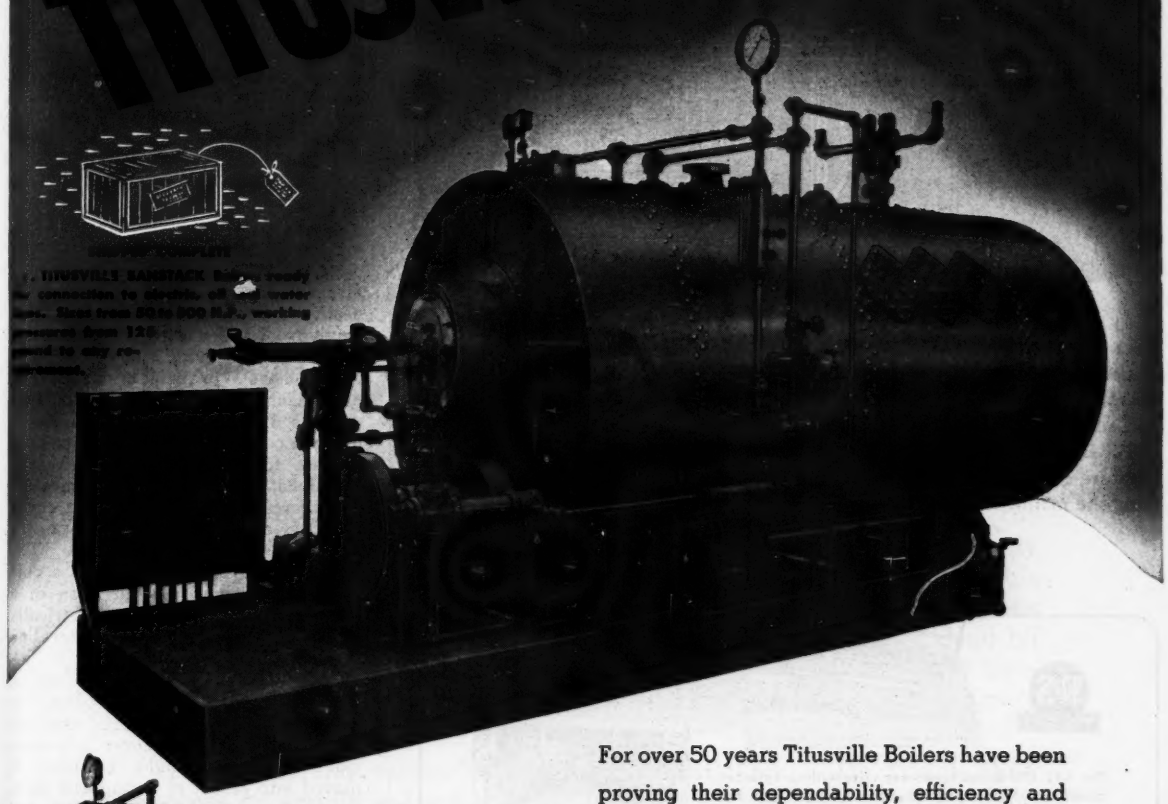
Insulation

In the field of insulating materials, one display showed four miniature gas-fired furnaces in full operation, into which four samples of insulating firebrick and fireblock were automatically introduced, heated and withdrawn to show their characteristics at temperatures from 1600 to 2600 F. These bricks are made in standard sizes and thickness, designed for quick application, light weight, easy cutting and fitting, and economical bonding.

A display of sectionally supported heat-enclosure material, used for boiler furnace and industrial furnaces, showed methods of suspension and construction of tile to provide controlled expansion and thus take account of the fact that all parts of a heat enclosure are not heated to the same temperature.

Year-in year-out performance records *prove* the dependability of

TITUSVILLE BOILERS



For over 50 years Titusville Boilers have been proving their dependability, efficiency and economy with outstanding performance records under the most difficult service and operating conditions in industrial and marine service, military, state and national institutions everywhere.

TITUSVILLE engineers will gladly cooperate with you—anytime.

STRUTHERS WELLS CORPORATION

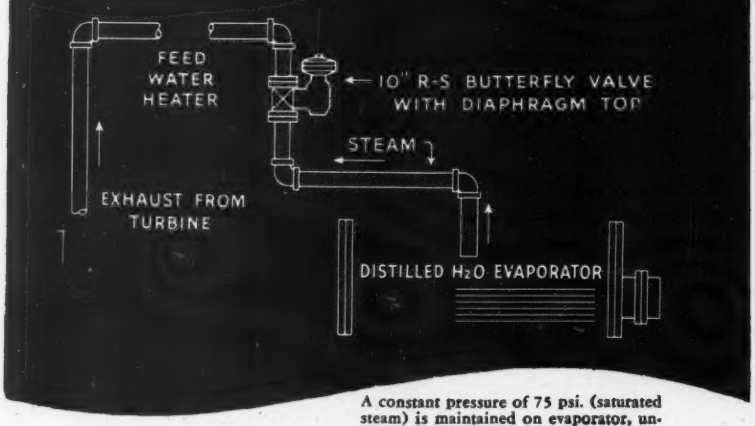
TITUSVILLE BOILER DIVISION

Plants at Titusville, Pa. and Warren, Pa.

Offices in Principal Cities

INSTALL WITH EASE

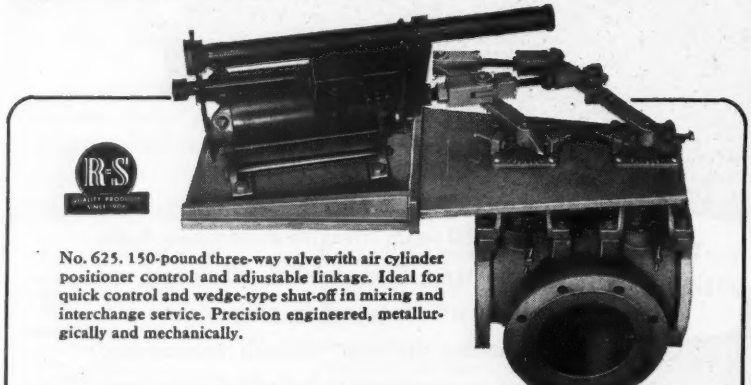
NO JAM! NO FREEZE!!



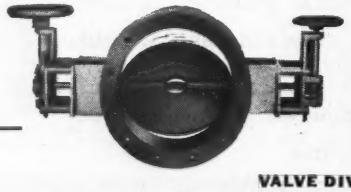
A constant pressure of 75 psi. (saturated steam) is maintained on evaporator, unloading to feed water heater.

Because of the comparatively light weight and compact construction of R-S Butterfly Valves, less supporting structure and space are required. As a consequence, substantial savings in installation costs are effected. Simplified design and standardized construction mean lower first cost and ease of installation.

R-S Butterfly Valves are machined to close tolerances depending on temperature conditions. There is no tendency to jam or freeze. In any line, they sting the maintenance bill every time. Ask for Catalog No. 14-B.



No. 625. 150-pound three-way valve with air cylinder positioner control and adjustable linkage. Ideal for quick control and wedge-type shut-off in mixing and interchange service. Precision engineered, metallurgically and mechanically.



No. 608. Designed for either a high pressure drop and small volume or a low pressure drop and large volume. The large vane seats against the body of the valve while the smaller vane is free revolving. Four to six revolutions of handwheel completely open or close vane. Adapted to power operation.

VALVE DIVISION

R-S PRODUCTS CORPORATION

4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

Insulation material made of glass fibers was displayed for a wide range of industrial and power plant uses. It was shown in the forms of blanket type pipe insulation for indoor and outdoor use for temperatures of heated surfaces up to 1200 F, in metal mesh blankets, blocks, insulating and finishing cements and as a wool for general purpose insulation. It was also demonstrated as a filter material in air filters.

Instruments

In the field of power plant and industrial instruments were shown new applications of vacuum-tube circuits. One new meter was displayed in which the unbalance of a bridge circuit produced by temperature or pressure is amplified by a vacuum tube amplifier to actuate a power element driving a recorder pen or controller mechanism. Temperature changes are detected by a temperature resistance bulb, pressure changes by a new device in which the electrical resistance of a conductor varies with the tension in it, a device which has been used as a strain gage. Advantages claimed for the new electrical type instruments are their speed of response, high dynamic balance without hunting and mechanical simplicity.

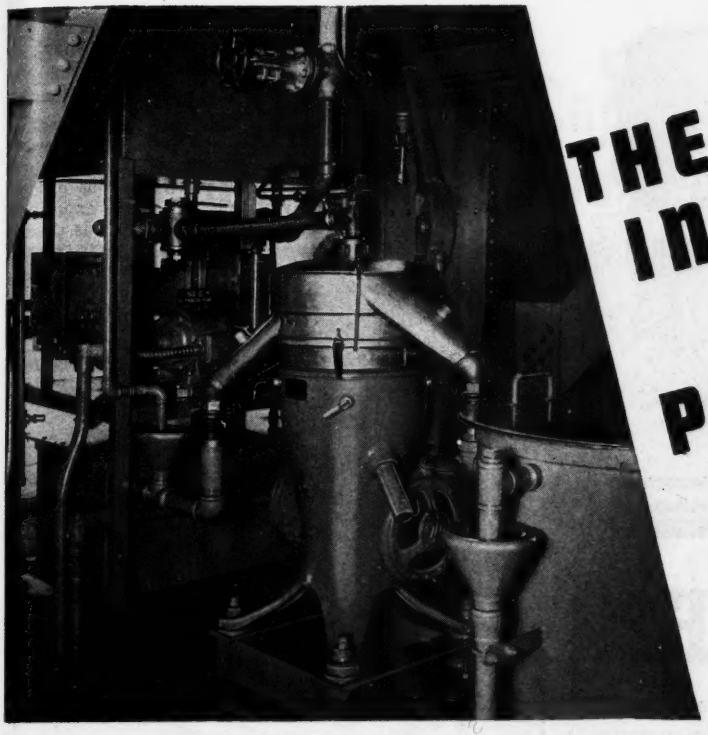
For measuring or controlling conductivity of boiler water or condensate, a new conductivity apparatus, also based on the Wheatston bridge method of measurement, was featured. This consists of conductivity cells installed to make contact with the water or condensate to be measured and a self-contained, portable meter for measuring the results. This will give a check on carry-over in boilers, and can be calibrated in grains per gallon. The controller, in addition, provides a current up to 2 amp for operation of a warning signal or other electrically operated device when the concentration exceeds a set point.

A new magnetic switch, for use on a flow control, pressure control or temperature control system employs the principle that a plunger in a non-magnetic pressure-tight chamber is moved into or out of a magnetic field, causing an armature to swing and open or close a mercury switch.

In an observation lens for installation in peep-holes, doors or other suitable locations in combustion chambers or boiler furnaces, the outer portion of the lens will darken when the fire makes smoke, while the clear central portion shows a reduced picture of flame, tubes, combustion space.

A new helicoid gear construction for pressure gages was demonstrated. This is intended to give continuous, progressive single-point contact between two gear elements and provide very smooth rolling action, prevent jamming and promote ease of adjustment.

In a new mercurial manometer for high precision work, hair line readings to 0.1 mm are possible with a magnifying eye-piece focussed on a thin-edge disc of stainless steel floating on the



THE ULTIMATE IN TURBINE OIL PROTECTION

A DE LAVAL-FUNK PROCESS

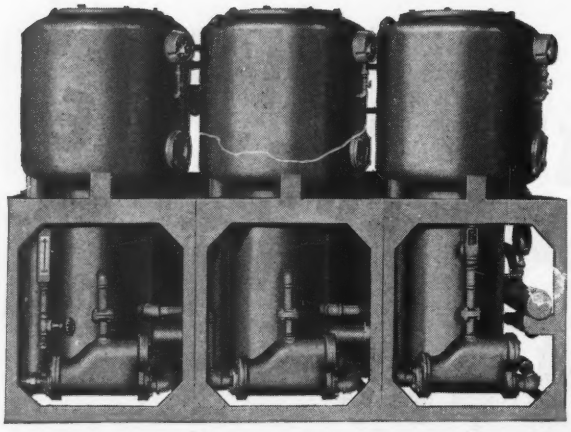
THE De Laval-Funk Process is the "last word" in turbine oil protection because it is the most effective means of (1) minimizing the formation of sludge within the lubricating system and (2) continuously purifying the oil. As sludge is generally recognized to be the real trouble maker in turbine oil lubrication, the De Laval-Funk Process helps check trouble at its source. Moreover, since an adequate supply of clean oil is the best safeguard known against bearing trouble, the De Laval Centrifugal which is the purification unit of the Process provides the ultimate in protection against such failures.

Whether the particular power plant calls for a De Laval-Funk Process or simply a De Laval Oil Purifier to keep the lubricating oil free from dangerous impurities and water, there is a wide range of capacities available from which to choose. Regardless of size or capacity, all De Laval Centrifugal Oil Purifiers maintain the oil in a condition most nearly identical with that of new oil, and make possible long, trouble-free service. Write for complete information.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

FOR MORE DEPENDABLE POWER PRODUCTION



PURE WATER

Water is perhaps the most abundant raw material in the world, but the chemical makeup and quality of most existing supplies is oftentimes improper for the intended use of the water.

HENSZEY *Distillation* SYSTEMS can deliver an abundance of absolutely pure water with a saving of half the fuel necessary to achieve the same results by means of conventional distillation equipment. Henszey units can be built in any desired capacity from 3,000 to 50,000 pounds per hour in one single compact unit. They can be fabricated from steel, stainless steel, monel, copper or combinations of above for specific use.

Send for new bulletin — just off the press.

HENSZEY COMPANY
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For
FOOD PROCESSING
•
MANUFACTURING
•
CHEMICAL FORMULATION
•
POWER PRODUCTION
•
HUMAN CONSUMPTION

HENSZEY
DISTILLATION SYSTEMS

Continuous Blowdown • Heat Exchangers • Boiler Feed Regulators
Feed Water Meters • Flow Indicators • Proportioning Valves

mercury column. Correction for expansion of the mercury column is made by stretching the scale over its entire length by means of a knurled nut.

Machine Tools and Production Equipment

Interest was high in the many machine tools and miscellaneous production devices included in the exposition. A trend especially evident was the use of light machine tools and portable tools in special and multiple applications for production work. These methods were worked out because of the scarcity of heavier machine tools and the time required to get them and some of them are so effective that they may become permanent practice. An example is the use of light drill presses in specially-designed rigs, also the use of band filing.

Among tools of interest to power men is a new hand file that smooths as it roughs. Its teeth are cut in an "off-center" arc; thus they become shorter and closer together on one side and when a surface is filed right to left with an overlapping stroke the file smooths out its own tracks as it goes.

Mechanical Transmission

Many of the exhibits featured mechanical transmission equipment of especial interest to production and process engineers as well as to power engineers. These included V-belt drives, flexible couplings, shafting, transmission and the like.

One coupling was shown of a molded non-metallic material of high tensile strength, not affected by friction, heat, grit, moisture or fumes. It is built with bore up to 5/8-in. diameter and capacity as high as 1½ hp at 1800 rpm.

A V-belt drive was shown with an adjustable belt of link construction, the length being adjusted to maintain uniform tension merely by removing links.

A handy device, where any magnifying device is needed in a shop, was an illuminated magnifier. This consisted of a powerful lens mounted on a handle containing a battery and lamp, the latter throwing a powerful light beam onto the field of vision.

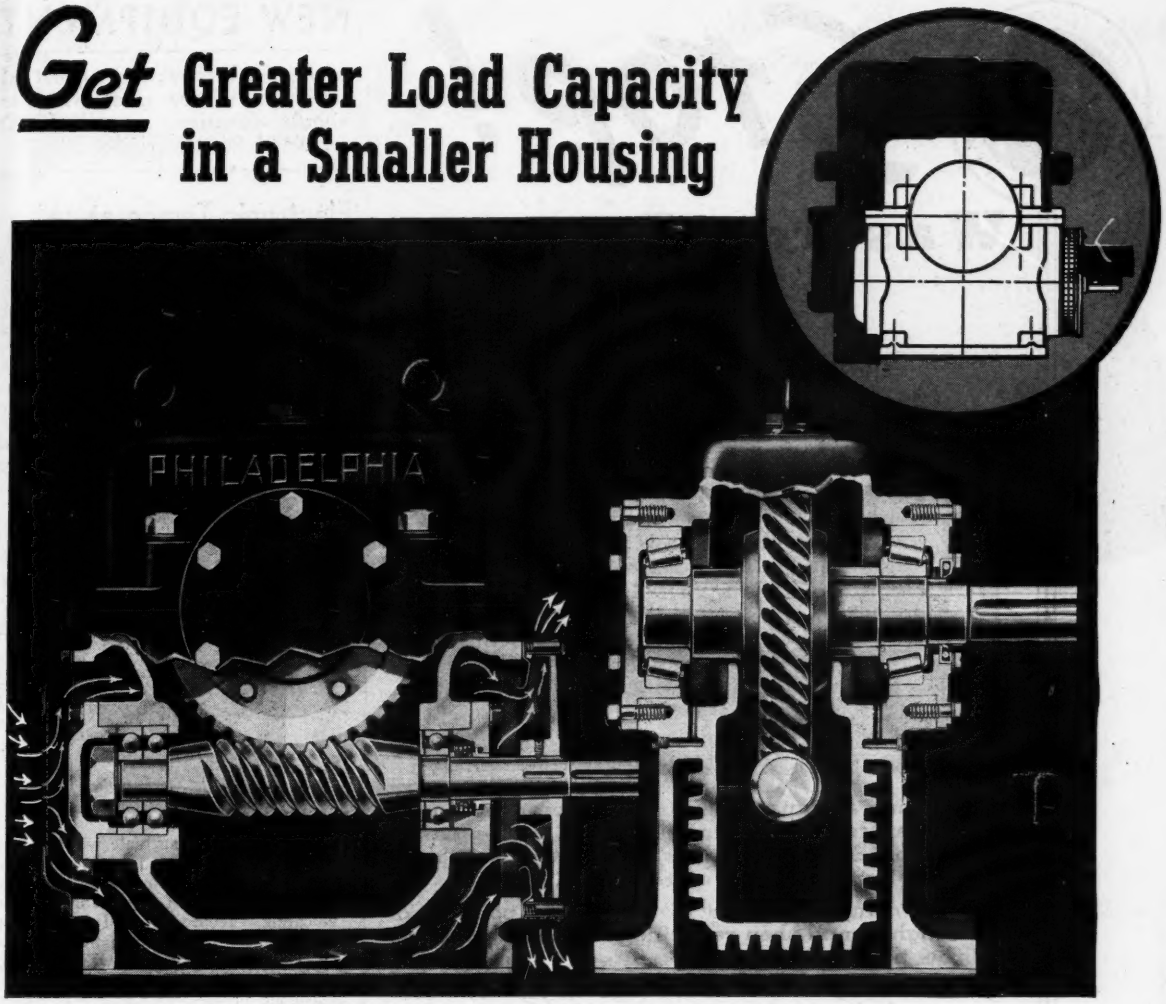
Capacitors Save Critical Fuel and Copper

(*Continued from page* 130)

fuses, discharge reactors and oil circuit breakers.

Capacitors carefully selected as to size and number are extremely flexible in their operation. For example, when the load falls off, one or more of the capacitors in the generating station or in the substation can be disconnected to preclude any possibility of the voltage rising to a point beyond good regulation limits.

Get Greater Load Capacity in a Smaller Housing



...with the Philadelphia AIR KOOLED Worm Gear Speed Reducer

At the upper right is shown the comparative sizes of a size 675 Type AT standard unit (in blue) and a size 475 AirKooled unit. Both deliver 20 HP at 1750 RPM. Ratio 4 6/7 to 1.

The cut-away drawings show the double-walled, finned housing and the flow of air around the oil reservoir.

Considerable *space* and *weight* savings have been made possible by the design of Philadelphia AirKooled Worm Gear Reducers as compared with standard heavy duty type worm gear units.

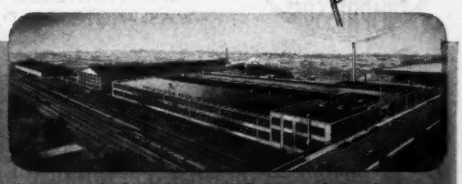
The AirKooled design features a suction fan, mounted on the worm shaft, which draws air through the double-walled, finned housing. This dissipates generated heat, and thereby maintains a higher contact oil film strength and greatly increases the horsepower ratings at worm speeds of 580 and 1750 RPM. For all ratios at 1750 RPM the ratings are approximately doubled, so the AirKooled unit is about two sizes smaller than a standard unit of the same capacity.

Let us tell you what these savings can mean to you.

SEND FOR BULLETIN 250 . . . . *on your Business Letterhead*

Philadelphia GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK • PITTSBURGH • CHICAGO

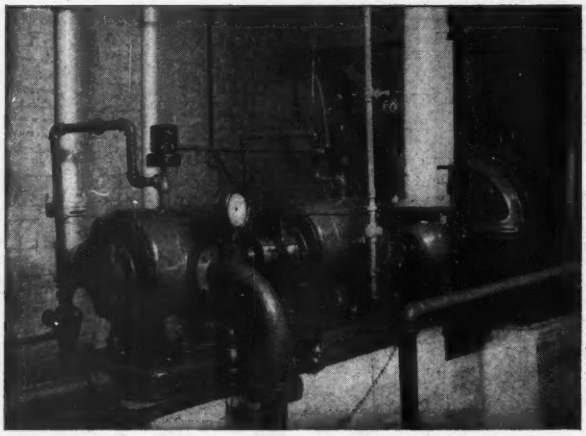


Industrial Gears and Speed Reducers
LimiTorque Valve Controls

YOUR COMPRESSORS spot WHERE YOU NEED THE AIR

Stop!

Wasting Power and Air



STOP that antiquated custom of compressing air at one central point, using large-size, high-pressure units working on pressures equal to the highest demand from any part of the plant.

STOP compressing air to a hundred pounds, or even higher, and then reducing it to lower pressures at the point of use.

STOP using long-distance pipe lines, with consequent leaks, and paying the added expense to prevent such leaks.

STOP paying out in power bills the excessive cost of forcing air through long transmission lines. Friction losses are direct losses.

STOP these costly practices . . . SPOT a Fuller Rotary Compressor where you need the air . . . at pressures required to do the work most efficiently and economically.

Write for Bulletin C-5

FULLER ROTARY COMPRESSORS

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

CHICAGO 3 : 1144 Marquette Bldg.
SAN FRANCISCO 4 : 421 Chancery Bldg.
WASHINGTON 5, D. C. : 618 Colorado Bldg.

C-93

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

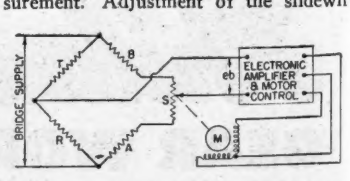
Electronic Temperature Recorder-Controller

AN ELECTRONIC type resistance thermometer suitable for indicating, recording and controlling temperatures between —100 F and 1000 F is announced by Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio. This recorder operates on the highly accurate null balance principle and provides instantaneous balancing action by electronic detection and control. Unbalance of the measuring bridge is detected by electron tubes.

A 29 in. indicating scale which circles the chart may be read easily at a distance of 50 ft. The pointer reading coincides with that of the recording pen. Indicating, recording and controlling mechanisms are all driven by the same reversible electric motor which adjusts the slidewire resistance to balance the measuring bridge. This motor is continuously connected to the electronic control unit which in turn is continuously connected to the measuring bridge as shown in the diagram.

Bailey Electronic Resistance Thermometers may be provided with as many as four recording pens, each one being provided with its own continuously connected electronic control unit and measuring bridge.

The temperature sensitive element is a platinum resistance wire, wound on a mica form and held between two mica sheets which are clamped by a metal frame. The element is further protected by a well which is permanently installed in the pipe line, furnace wall, duct, or other point of temperature measurement. The temperature element is diagrammatically represented by the resistor T. Resistors R, A and B are fixed and are designed to provide proper range of measurement. Adjustment of the slidewire



T = TEMPERATURE SENSITIVE PLATINUM RESISTANCE
A, B & R = FIXED RESISTORS
S = SLIDEWIRE
M = SLIDEWIRE DRIVE MOTOR

Insure Better Performance

Specify Ladish *Controlled Quality* Forged Steel Pipe Fittings

Ladish forged steel fittings, carbon and alloy, are produced under exacting metallurgical control. Every Ladish fitting bears the symbol of Controlled Quality—the Ladish Heat Code.

Forged Steel Screwed Fittings

Full depth thread, accurately cut, results in pressure-tight joints. Pipe enters easily. Uniform thickness. Sizes clearly marked . . . ⅛" through 4".

Socket Welding Fittings

Speed up installation because deep sockets save time formerly required to cut pipe to exact length. Socket supports pipe and allows self-alignment. No machining of pipe necessary for fit. ASSURED WELDABILITY. Sizes clearly marked . . . ⅛" through 4".

ARMY E NAVY

TO MARK PROGRESS

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

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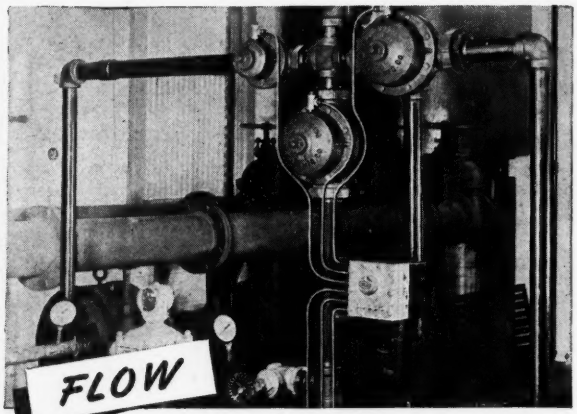
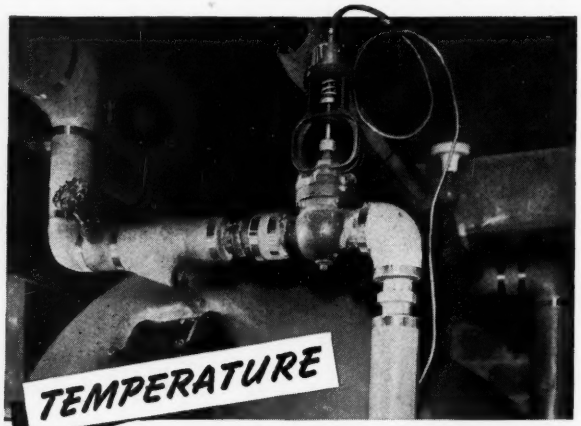
HOW INDUSTRY MEETS EXACTING REQUIREMENTS FOR CONTROL OF...

Here McAlear pressure regulators maintain constant reduced steam pressure in large Government Housing Project.



McAlear Pilot Operated Diaphragm Valves, controlling flow of hard-to-handle liquid in processing plant.

H-W 850 Displacement Level Controller on Stabilizer Reboiler. Controls liquids of any gravity, temperature or working pressure.



McAlear No. 3100 Temperature Control Valve holding constant temperature in feed water heater. Available in ranges of 40° each, from 75° to 260° F.

DEVELOPING high precision controls for more than 500 different, specific applications in power and process industries—over a thirty year period—has produced a McAlear precision control for almost every conceivable power or process requirement—*precision engineered,* metallurgically and mechanically, to give long, trouble-free service.

FOR EVERY APPLICATION—involving control or regulation of temperature, flow or pressure of steam, water, air, gas, chemicals or oil—McAlear either has the control instrument you need, or—will develop a special control where *unusual* conditions require it. For descriptive bulletins and catalog, write McAlear Manufacturing Company, 1915 S. Western Avenue, Chicago 8. *Affiliated with: Hanlon-Waters Company, Tulsa; Climax Engineering Company, Clinton, Ia.*

H-W
McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL—GAS
WELDED TANKS
BOLTED TANKS
SEPARATORS

McALEAR NO. 3100 TEMPERATURE CONTROL VALVE for steam, water and gas. Readily adjustable to any temperature within ranges of 40° each, from 75° to 260° F. Sizes ½ to 4 inches. Used in process industries and power plants.

Bronze bulb and brass fittings standard—other metal combinations for special uses. Other types in sizes ½ to 8 inches.

IT WAS ABOUT TIME for someone to design a better zeolite softener!

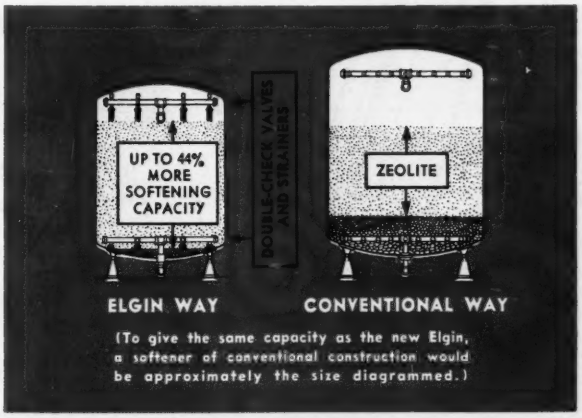
ELGIN DID IT . . . with the "DOUBLE-CHECK" DESIGN

UP TO 44% MORE SOFT WATER

UNTIL the new Elgin water softener was developed, zeolite softener design had simply gone along the beaten path. One simple, but very basic change—the Elgin "Double-Check" manifold—marked the turn onto a new road. Up to 44% more soft water . . . prevention of zeolite loss . . . better backwashing . . . lower salt consumption . . . these are the accomplishments of the new Elgin softener, fully confirmed by a long list of users.

The reason for this is clear cut: The "Double-Check" arrangement permits placing far more zeolite in a softener of given size and prevents escape of zeolite. More zeolite means more soft water output. The manifold design also permits better backwashing and prevents packing and channeling. As a result, the brine reaches every portion of the zeolite, giving complete, efficient regeneration with less salt consumption.

The diagram tells the story. A softener of conventional design would have to be as much larger as shown to give equal soft water output, and of course its operating and maintenance cost would also be proportionally greater. *For the story of the new Elgin write for Bulletin 603.*


UP TO 44% MORE SOFTENING CAPACITY
DOUBLE-CHECK VALVES AND STRAINERS
ZEOLITE
ELGIN WAY
CONVENTIONAL WAY
(To give the same capacity as the new Elgin, a softener of conventional construction would be approximately the size diagrammed.)

YOU CAN STEP UP THE CAPACITY OF YOUR PRESENT SOFTENER

The "Double-Check" principle is adaptable to your present softener regardless of make. This change, along with Elgin High Capacity Zeolite, will give you greatly increased soft water output at surprisingly low cost. Ask for facts.

ELGIN
ECONOMICAL WATER CONDITIONING

ELGIN HAS THE ANSWER—

Elgin is known for achieving results at lowest possible cost. The complete Elgin line includes: Boiler Water Treating and Purifying Systems • Feedwater Treatment • Deconcentrators • Heat Exchangers • Water Softeners • Filters and Purifiers • Iron Removal Equipment • Aerators • Water Treating Chemicals • Chemical Feeders • Scale and Corrosion Inhibitors • Sample Coolers • Water Testing Equipment • Zeolites

ELGIN SOFTENER CORPORATION, 136 North Grove Avenue, Elgin, Illinois

Brings added *Safety* to Boiler Room Operation

Tested for SHOCK Resistance!

In repeated tests SONDERGLASSES have been dipped in hot oil 450 F. then quickly plunged in cold water without breaking . . . Besides protecting boiler room operators against the possibility of getting cut from broken gauges, SONDERGLASS gives better visibility, lasts longer, costs less per year of service than ordinary gauge glasses. Order SONDERGLASS from your steam supply man or directly from us.

1. CLEAR

In TWO Popular Types

2. REFLECTING

SONDERGLASS

A. W. CHESTERTON CO., 64 INDIA ST., BOSTON, MASS.
Distributors in Principal Cities

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

contact on the resistor S subtracts resistance from A and adds resistance to B or vice versa. Thus, the bridge is balanced by adjusting the ratio of the bridge arms and the necessity of carrying bridge current through the slidewire contact is avoided. Variations in contact resistance are thus prevented from affecting calibration.

Since alternating current is used for the bridge, no battery source of bridge voltage is needed. Standard voltage cells and voltage standardization equipment are not required.

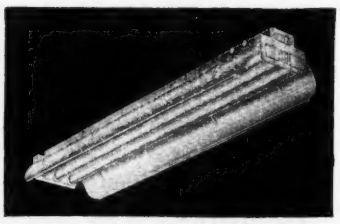
Bailey Air-operated Control, Electronic Control or contacts for on-off electric control may be provided for as many as two temperatures by the multiple pen Bailey Electronic Recorder-Controller. The control mechanisms required are mounted inside the recorder-controller casing and are actuated by the same reversible motors which drive the recording pens.

Alarm contacts may be provided for any or all of the recorder units. These contacts are operated by an adjustable cam which may be set to trip at any desired position of the recording pen.

Temperature measuring circuits may be arranged to calculate the sum, difference and ratio of temperatures. Calculated results are recorded directly by these recorders.

New, Safe Industrial Fluorescent

A NEW industrial and utility lighting-fixture for use with 2-40, 3-40 and 2-100 watt fluorescent lamps has just been announced by the Edwin F. Guth Co., St. Louis, Mo. The new Maze-Lite is built of heavy-gage steel throughout, made possible by the War Production Board's recent release of heavy-gage steel for lighting purposes.



Made entirely with dies, it is strong and rigid, and is durably finished. Its reflector is available with either Porcelain Enamel (1200°) surface, or with Synthetic Enamel (300°) surface. Reflector-ends are rounded to eliminate sharp corners for maximum safety-conditions.

The Maze-Lite can be had with hot-cathode or cold-cathode auxiliaries, and its reflector provides high light-utilization with normal lamp shielding.

Lo-Hed Electric Hoist

AMERICAN ENGINEERING Co., Philadelphia 25, Pa., announces its ¼ Ton Electric Hoist, which is built to big hoist specifications, with heavy construction throughout, and brings to the field of 500 lb capacity hoists a new standard of workmanship and performance.

The motor is a heavy duty ¾ hp hoist and crane type motor with high starting torque. Gearing is heavy-duty spur type. The lowering brake is automatic, heavy-duty Weston screw-and-

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Condenser Tubes Severely Taxed

Overwork and Unavoidable Neglect Can Be Offset by More Corrosion Resisting Alloys

Recent personal interviews with a considerable number of power plant engineers in various parts of the country indicate that today's job of supplying electricity, especially in industrial sections occupied with war work, is as big as ever. All available equipment has been put into service. The engineer's job is much more difficult than in peacetime because of long hours and a critical labor shortage. In some cases, this means reduced maintenance of condensers resulting in less efficiency and shorter tube life. More corrosion resisting condenser tubes are needed that can stand up under unavoidable neglect and overwork.

Test Lots Indicate Best Alloy

In many places such as seaboard locations especially in harbors and bays, the circulating sea water is badly contaminated with sewage and factory wastes. In some cases, Admiralty condenser tubes last only two years. DURONZE IV is recommended here and should be given at least a trial as soon as possible.

Engineers planning for future expansion when new equipment will be available, are in some instances putting in test lots of several different condenser tube alloys for periodic observation in order to determine definitely which alloy will serve best. Bridgeport's Laboratory will be glad to cooperate with any forward looking engineers who really want to know what's best under existing operating conditions.

Periodic Examination Important

An engineer should periodically examine his condenser tubes to prevent premature failure due to conditions that are avoidable. For example, in the case of several condenser installations using the same water supply, the condenser nearest the source was being affected by impingement corrosion much more than those farther away. Examination of the one which was giving the most trouble showed the presence of shells and debris which had blocked many of the tubes and had greatly increased the rate of water velocity in the tubes which were not covered. The exposed tubes were failing rapidly. Frequent cleaning and proper maintenance of the screen could have prevented the entrance of the greater portion of the objectionable material and prevented the blocking of the condenser.

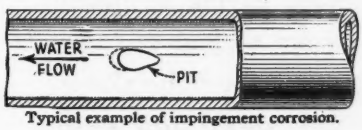
Fighting Impingement Corrosion

In another station excessive impingement corrosion of Admiralty was laid to high velocity and entrained air. If careful checkup of pump glands and system to eliminate air is not effective, it is necessary to use alloys such as CUZINAL or DURONZE IV that are more resistant to impingement corrosion.

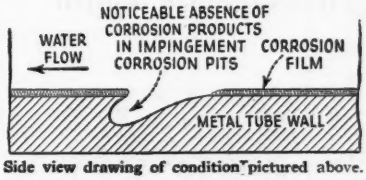
A visit to a chemical plant revealed that steel tubes conveying amine solutions were corroding badly on the outside by circulating sea water. Here is an instance where Duplex tubing—steel on the inside and Admiralty outside—would solve a bad situation.

Bridgeport offers a number of modern corrosion-resisting condenser tube alloys which are designed to stand up under severe conditions of operation existing during wartime. Our laboratory services are available to help select the alloys which will give the best service.

If you do not have a copy of Bridgeport's Condenser Tube Manual, write for it today on company stationery.



Typical example of impingement corrosion.



Side view drawing of condition pictured above.

Revised Duronze Manual Features Product Improvement

Bridgeport Brass Company has recently published a revised edition of their 80-page DURONZE Manual. It contains specifications and technical data on five copper-base engineering alloys in the form of sheet, rod, wire and tubing. Many applications are suggested for the manufacture of strong, wear and corrosion resisting parts by hot forging, cold forging and machining.

Outstanding is DURONZE III, an Aluminum Bronze modified by silicon, which is approximately 50% stronger than brass, 9% lighter in weight, and has exceptional resistance to corrosion from sea water. Because of its low coefficient of friction when in moving contact with steel and most other materials, it is excellent for valve stems for steam valves, pump parts, marine hardware, etc. This alloy is free machining.

DURONZE III hot forgings, approximately twice the strength of brass forgings, are replacing gears, valve stems, seats and bushings, rollers, and similar items made from steel or cast bronze. It is also used for

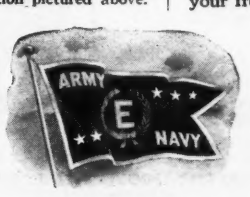
outdoor electrical equipment, wire and cable connectors and other parts which must withstand exposure, weathering, smoke and dirt. Because DURONZE III is approximately 50% stronger (in the annealed condition) than Naval Brass, and 9% lighter in weight, 40% to 50% in dead weight can be saved without any sacrifice in yield and tensile strengths by using DURONZE III instead of Naval Brass. This weight and space saving can be utilized on shipboard, for example, to carry a paying load.

Write today on company stationery for your free copy of the DURONZE Manual.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

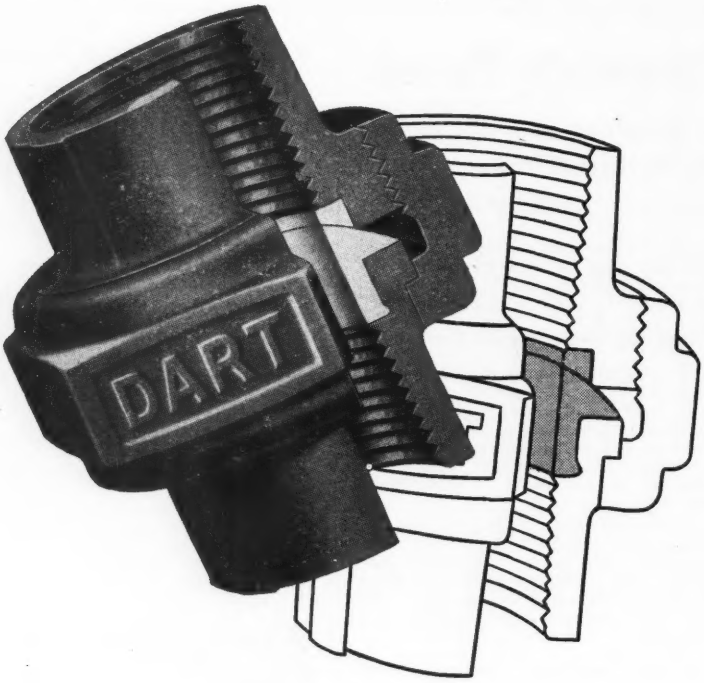


BRASS

ESTABLISHED 1865

DEFINITION OF A DART

TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT



TWO bronze seats, ground to a true ball joint defines just one union—Dart. In other words, Darts are different. The super-smooth seats join without jamming; part without having to pound them. Dart bodies and nuts are of high-test, air-refined malleable iron—are practically unbreakable. That's why Darts can be used ***over and over again,*** reaching lowest cost levels through ***length of service.***

Order Darts from your supplier now, and **see** the difference.

DART UNIONS

E. M. DART MFG. COMPANY, PROVIDENCE 5, RHODE ISLAND

disc type. The electric crane, built integral with motor, has full load torque capacity. The push button control pendant and control cord are heavy duty, with the super-service cord reinforced by a steel pull cable. Chassis is heavy-gage pressed steel.

The weight of the Lo-Hed ¼-Ton Hoist is 195 lb for the bolt suspension type, and 225 lb for the plain trolley type. The trolley is specially designed to withstand the initial shock of electric hoisting and lowering.

Constant Level Lubricator

TO THE FIELD of industrial lubrication, Oil-Rite Corp., 3499 South 13th St., Milwaukee 7, Wis., has introduced the Constant Level General Purpose Lubricator, Style B, which offers a reliable, automatically controlled, visible oiling method for most types of bearings.

Once installed, it needs only periodic refilling at long intervals. A glance at the visible oil reservoir indicates when it is necessary to replenish the extra supply.

When reservoir is filled with oil, only enough oil will be released from the reservoir to bring the level in bearing oil well to the oil level line marked on the base of the lubricator. When the bearing oil level falls, air is admitted into the reservoir through a vent, thus automatically releasing just enough oil to restore the original level.

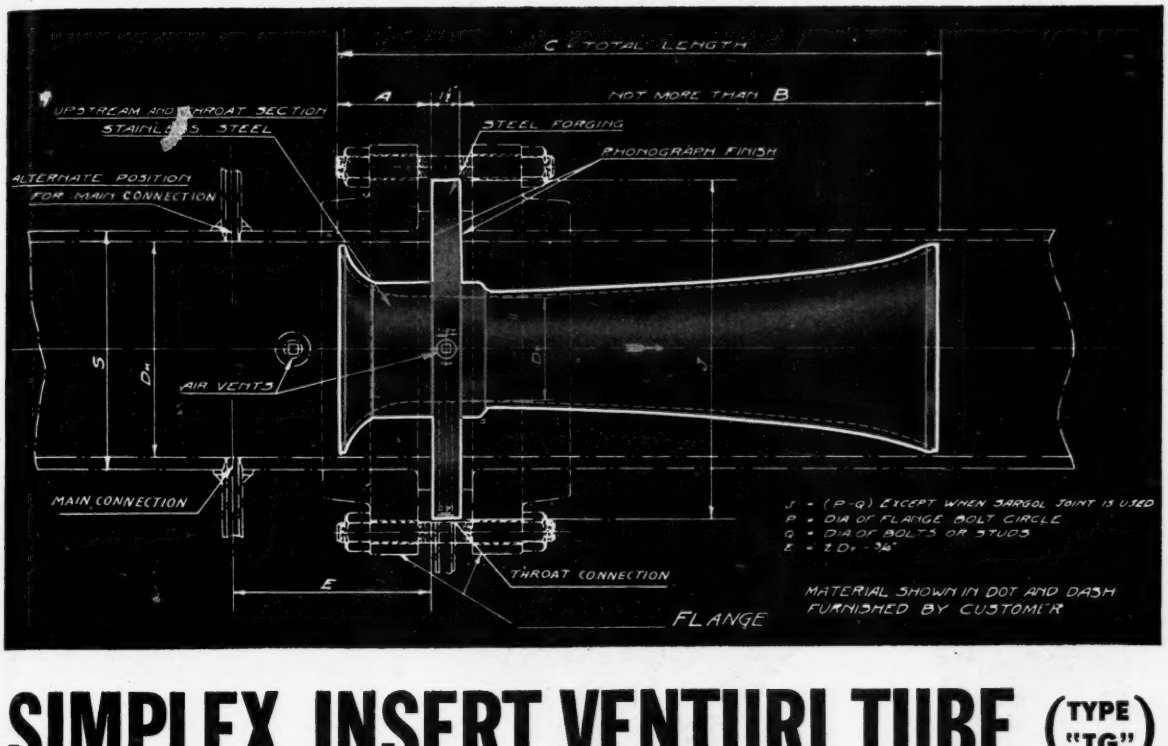
Construction consists of two parts. The base has bottom and side outlets for oil, either or both of which may be used for bearing feed. Large air vents can be connected to a filter or to a breather tube on the bearing. Oil level is definite and clearly marked on the outside. Large passages for oil and air permit easy flow of lubricant especially with heavy oils. A conveniently located thumbscrew permits easy removing of reservoir for refilling.

The reservoir is sealed to a collar with plastic cement, which is not affected by oil, water, heat, or acid. A spring stopper prevents spilling of oil when filling.

These lubricators are available in five sizes with capacities of 1, 2, 4, 8, and 16 ounces.

Silicone Insulating Resins

DOW CORNING CORP., Midland, Mich., announces that a new class of organo-silicon insulating materials are now in commercial production. These new products are reported to have exceptional heat stability, resistance to


C = TOTAL LENGTH
A
NOT MORE THAN B
UPSTREAM AND THROAT SECTION STAINLESS STEEL
STEEL FORGING
PHONOGRAPH FINISH
ALTERNATE POSITION FOR MAIN CONNECTION
AIR VENTS
MAIN CONNECTION
THROAT CONNECTION
FLANGE
J = (P-Q) EXCEPT WHEN SARGOL JOINT IS USED
P = DIA OF FLANGE BOLT CIRCLE
Q = DIA OF BOLTS OR STUDS
E = 2 D1 - 3/4"
MATERIAL SHOWN IN DOT AND DASH FURNISHED BY CUSTOMER

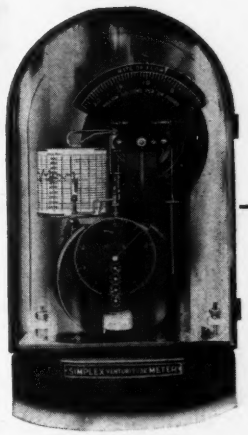
SIMPLEX INSERT VENTURI TUBE (TYPE "TG")

with MO Flow Rate Meter

INSTALLED IN EXISTING LINES... PROVIDES STANDARD VENTURI HEAD QUANTITY

Simplex "TG" Tubes are easily inserted in pipe lines of 3" diameter and up, and provide a convenient, accurate means of establishing differential head characteristics which are as dependable as those obtained from standard Venturi Tubes, with a loss of head considerably lower than in orifice plates.

For high or low pressure lines any required material may be used such as steel, bronze, stainless steel, cast iron, etc. The flange can be furnished to fit any type of pipe joint or welding ring. The cost of a "TG" Tube is relatively low.



THE SIMPLEX MO METER

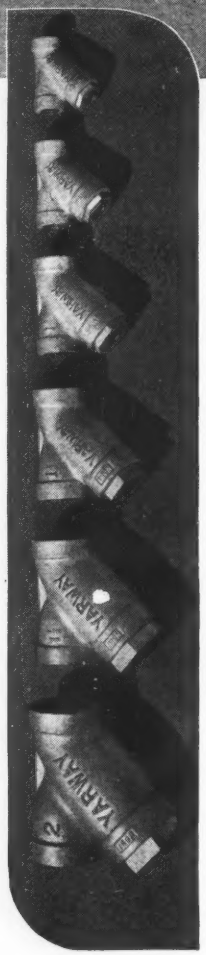
Simplex "TG" tubes in combination with MO Meters (indicating, recording, totalizing) are widely used for the accurate flow rate measurement of water, oil, gases, air, and industrial liquids. Many power and industrial plants measure fluids of all types with this simple, efficient, primary device and meter, which converts differential pressure heads into rates of flow.

Write today for further information and details of installation of Simplex "TG" Insert Venturi Tubes.

SIMPLEX VALVE & METER COMPANY

6783 UPLAND STREET, PHILADELPHIA 42, PA.

A Better STRAINER



- Cadmium Plated Inside and Out
- High-Grade Woven Monel Wire Screen
- Readily Removed Steel Blow-Off Bushing
- Screen and Bushing Come Out Together—Go Back Together, Automatically Aligning
- For Steam Lines or Water, Oil and Other Fluids
- Reasonably Priced
- 6 Sizes from ½" to 2" for Pressures up to 600 lbs
- Many Thousands in Service
- Sold by Over 100 Mill Supply Houses

See Your Supply House or Send for Bulletin S-200

YARNALL-WARING COMPANY
114 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

moisture, and freedom from carbonization at high operating temperatures.

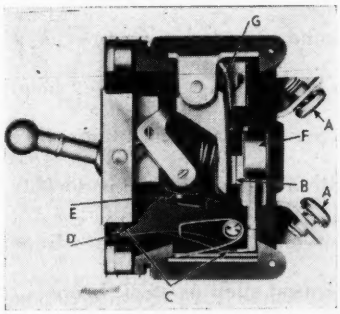
Several types of these resins have been under development, each designed for specific use. One is employed as an impregnant and coating for Fiberglas served magnet wire and for woven Fiberglas electrical tapes, cloth and sleeving. It requires high temperatures to cure to a tack-free state; 1 to 3 hr at 250 C or shorter times at 350-400 C. This combination of Dow Corning 993 with Fiberglas electrical textile provides flexible continuous insulating constructions which withstand long operating temperatures of 150-200 C in electrical equipment. A third type represented by Dow Corning 2052, is intended as an impregnant and thermosetting dielectric for rotating parts of electrical equipment. On baking at 200 C, it sets throughout its cross-section to a relatively hard resin which does not flow. It was designed primarily to be resistant to centrifugal displacement in parts of electrical equipment rotating at high speeds and at elevated temperatures. These resins were designed primarily for use with inorganic materials such as Fiberglas, asbestos and mica.

Bi-Metal Circuit Breaker

A NEW CIRCUIT BREAKER relatively free from the effects of extreme high and low temperatures is announced by Littelfuse Incorporated, 200 Ong St., El Monte, Calif.

The actual trip temperature of the new breaker without flow of current is 350 F ambient temperature. This feature is accomplished by new bi-metal design. There is, of course, a clear distinction between operating and ambient temperatures. The high differential between operating and breaking temperatures is a distinguishing characteristic of this circuit breaker.

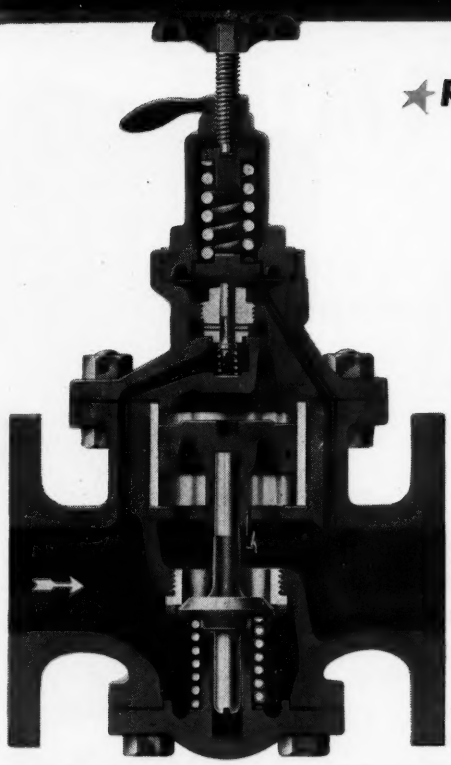
In the Littelfuse, the bi-metal is used as the finger to trip the breaker. The importance of the achievement toward



temperature compensation through design and function of the bi-metal, is indicated by the common experience of tripping at high temperatures. Between such extreme temperatures as 180 F and –90 F, the Littelfuse breaker performs with small variations in ultimate trip values. The Littelfuse switch breaker No. 1560 (AN3160) is of switch type, non-trip free, performance specification AN-C-77.

The range is 5 to 50 amp at 32 v, a-c or d-c. It is capable of breaking 2500 amp on short circuit. It meets the requirements of holding for one hour at 115 per cent of rated current; breaks within the hour on 138 per cent of rated current; breaks at 200 per cent of its load between 10, and 100 sec. These tests are all at the ambient temperature of 77 F + 1.8 F.

Leslie Regulating Valves

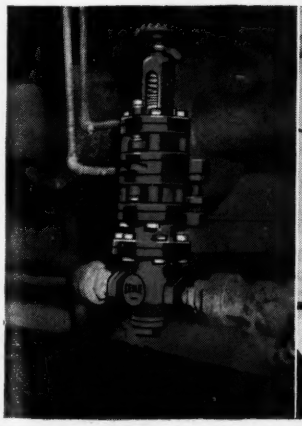


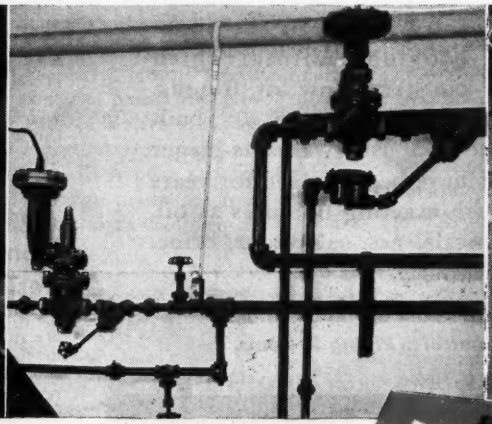
★REDUCE MAINTENANCE
★PROVIDE CLOSER CONTROL
AT WHITE LABORATORIES!

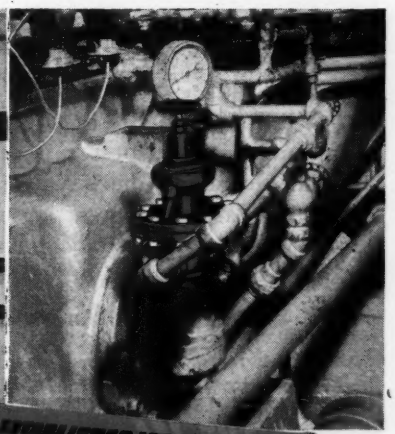
WHITE LABORATORIES can tolerate no deviation from set process steam pressures, in spite of widely fluctuating loads, in the manufacture of its vitamin products and other pharmaceuticals. At the same time, maintenance must be kept within reasonable limits.

TO REDUCE FREQUENT AND COSTLY REGULATOR MAINTENANCE, Norman E. Smith, Chief Engineer, began installing Leslie products back in 1932. Now there are 60 Leslie Pressure Reducing Valves in the Boiler House, Manufacturing Plant, Compressed Air and Air Conditioning Systems—as well as Leslie Pump Governors and Leslie Temperature Regulators. Yet only one Leslie product has needed a major repair in these twelve years.

THE PRINCIPLE OF THE SPRING-LOADED INTERNAL PILOT, PISTON-OPERATED VALVE, developed by Leslie, is responsible for this combination of ruggedness with unusual sensitivity and accuracy. The bronze body valves are of 88-10-2 composition, enabling them to withstand pressures to 300 p.s.i. and temperatures to 550 degrees F. Cast steel valves are designed for 600 p.s.i. and temperatures to 750 degrees F. The main valve seats are Stellited to 600 Brinell and the main valves are surface hardened to 800 Brinell.







(Left, above) **WIDE LOAD CHANGES** demand fast acting, accurate pump governors such as this Leslie, standard equipment for White Laboratories fuel oil and feed water pumps.

(Center, above) **LESLIE TEMPERATURE REGULATORS** employed in White Laboratories include the self-contained unit at the left and the auxiliary operated unit at the right.

(Right, above) **LESLIE PRESSURE REDUCING VALVES** get many unusual jobs at White Laboratories. Here, in the oil feed line, a J-1 model safeguards the air conditioning air compressor from shut-downs.

ESTABLISHED 1903

LESLIE

REGULATING VALVES
LESLIE-TYFON WHISTLES

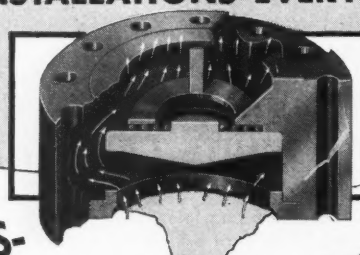
ARMY-NAVY E

LESLIE CO. • LYNDHURST • NEW JERSEY

Preventing . . .

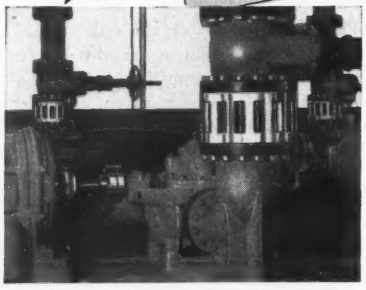
COSTLY, DESTRUCTIVE "WATER HAMMER"

WITH INSTALLATIONS EVERYWHERE!



WILLIAMS-HAGER

FLANGED Silent CHECK VALVES



Three 10"-300 lb. Williams-Hager Flanged Silent Check Valves in Radio City, N. Y.

Eliminates

Costly Breakdowns in Pumps and Piping Systems with Operating Pressures up to 6000 lbs!

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provides uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, salt water, brine, etc., etc., regardless of temperature.

Write today for interesting folder on "Water Hammer—Cause, Effect and Control in Piping Systems."

THE WILLIAMS GAUGE COMPANY

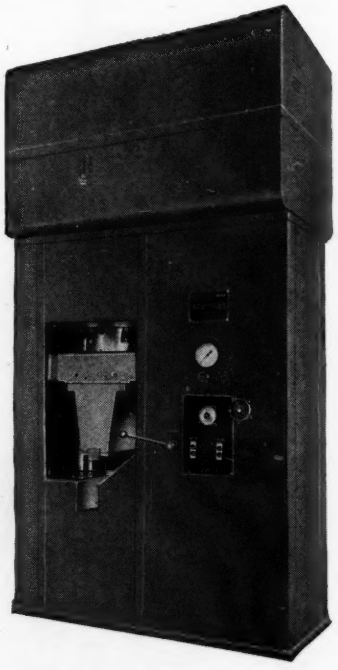
Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 PENNSYLVANIA AVENUE • PITTSBURGH (12), PA.

Powdered Metal Press

THE WATSON-STILLMAN Co., Roselle, N. J., has recently developed a hydraulic press for briquetting parts from powdered metal. This press is designed to simplify powdered metal molding operations and give a high degree of accuracy and consistently uniform structure density in finished products.

The press has a 400-ton capacity vertical ram and a 300-ton capacity horizontal ram. It is double acting with controls and adjustments conveniently located for the operator. Continuous performance and exact duplication on production runs are assured by smooth, pulsationless pressure application, accurate stepless pressure adjustment and automatic cycle controls. The mold size is 6-in. wide by 7-in. deep by 30-in. long, and the working parts are enclosed in dustproof housing. The press is 11-ft 6½-in. high and occupies floor space of 6-ft 2-in. by 2-ft 7-in. Its weight is approximately 28,000 lb.



Control For Resistance Welding

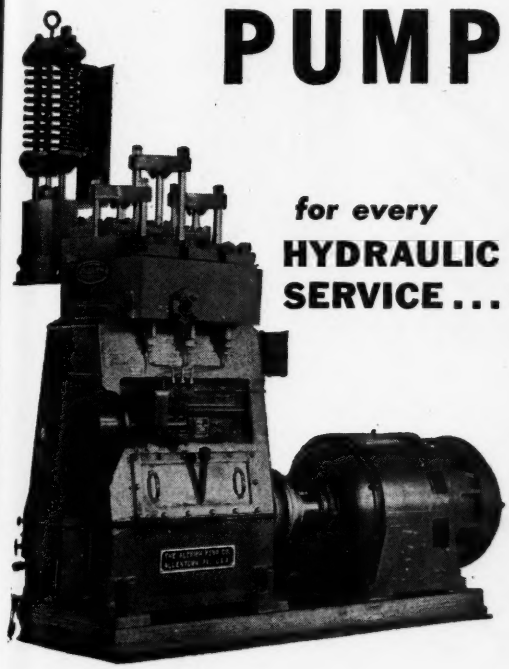
A NEW PRECISE electronic forge-pressure timer has been incorporated in the G-E line of capacity discharge controls for use with stored-energy type resistance welding machines, it has been announced by the Industrial Control Division of the General Electric Co. The new timer, which is designed for dual presssure spot welding machines of the capacitor discharge type, functions to supply accurately timed forge-pressure, so that the required welding energy, cracks, indentations, and sheet separation are reduced.

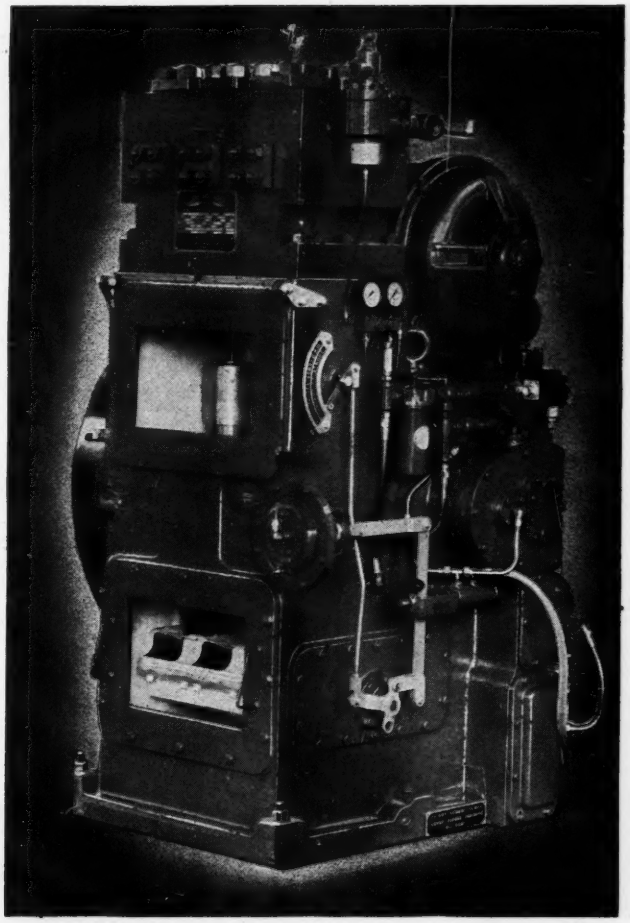
Calibrated in milliseconds, the timer consists of a timing circuit with a regulated d-c source of voltage to assure accurate timing; the necessary electronic tubes; and a time-delay relay with fixed timing for compensating for the

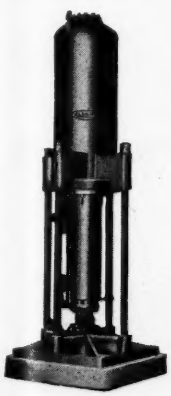
. . . THERE IS AN

ALDRICH PUMP

for every HYDRAULIC SERVICE . . .







The Aldrich-Groff Controllable Capacity Pump (*above, right*). A variable stroke vertical triplex pump fitted with automatic control mechanism to deliver from 0 to 100% rated capacity at constant pump and motor speed. Control of rate of delivery can be accomplished from any remote point, manually or automatically. Will handle any free-flowing liquid at discharge pressures from 200 to 15,000 p.s.i. In sizes ranging from 5 to 100 HP.

Aldrich-Groff Pumps can also be furnished in a constant-stroke type with variable speed (d.c.) motor.

Aldrich Inverted Vertical Triplex Pump (*above, left*). A high pressure constant-stroke pump. Drive arrangements can be direct through gear-head motor as shown, through built-in pump gearing from extended pinion-shaft, or by chain, flat or V-belt from extended crankshaft. Can be fitted with Aldrich Patented Synchronized Suction Valve Control for services on hydraulic systems.

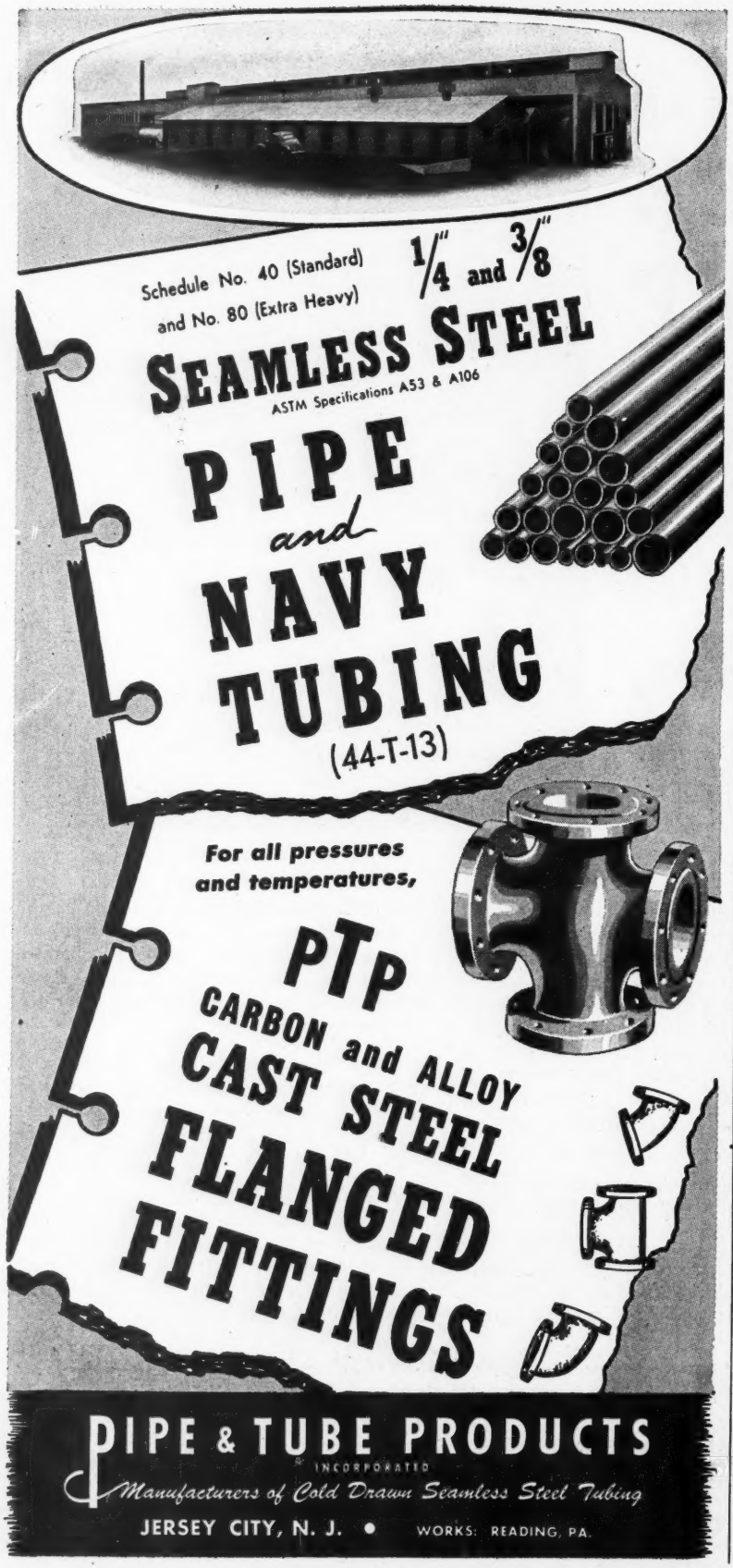
• Other Vertical Triplex Pumps with various forms of drive from 2½ to 400 HP and working pressures up to 15,000 p.s.i. built for long life under the severest operating conditions.

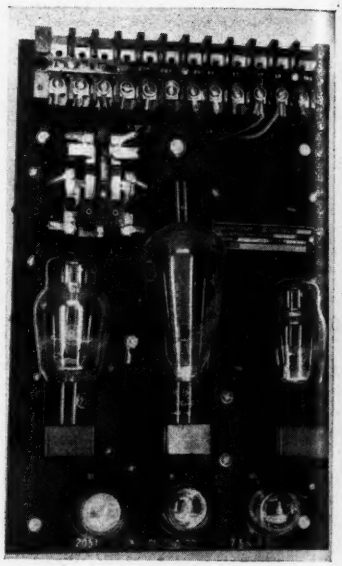
• Also, Aldrich Accumulators in various designs to meet any requirements; hydropneumatic plunger and piston types (*shown left*); dead weight or gravity types. Alleviators; Synchronized and non-synchronized suction valve controls.

Our engineering department will gladly consult on all pumping and hydraulic problems. Bulletins and data sheets of any type pump in the Aldrich line will be sent on request.

THE ALDRICH PUMP CO. ALLENTOWN • PENNA.

Representatives: Birmingham • Bolivar, N. Y. • Boston • Chicago • Cincinnati • Cleveland • Denver • Detroit Duluth • Houston • Los Angeles • Pittsburgh • Portland, Ore. • St. Louis • San Francisco • Seattle • Tulsa





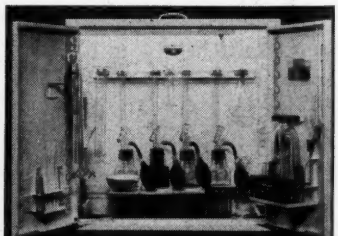
delay in the operation of the solenoid valve on the welding machine, so that the forge-pressure can be applied precisely at any point during the current discharge.

A feature of the new timer is that it is mounted on a small steel base so constructed that it can be added to any G-E capacity discharge control already installed, providing the resistance welding machine has a dual pressure system designed for this purpose.

Multitest Cabinet

FLEXIBLE and convenient apparatus for the testing of water samples is provided by the new Multitest cabinet manufactured by the Bird-Archer Co., 400 Madison Ave., New York City. It is compact, and is devised to accommodate any one or all of the following tests: hardness, alkalinity, chloride, phosphate, pH, sulfite, sulfate and dissolved oxygen. The testing equipment can be rearranged at will.

It is equipped with glareless fluorescent lighting, so that the most delicate end-point may be seen, and specially designed titration tables help to eliminate any possible splashing of sample.

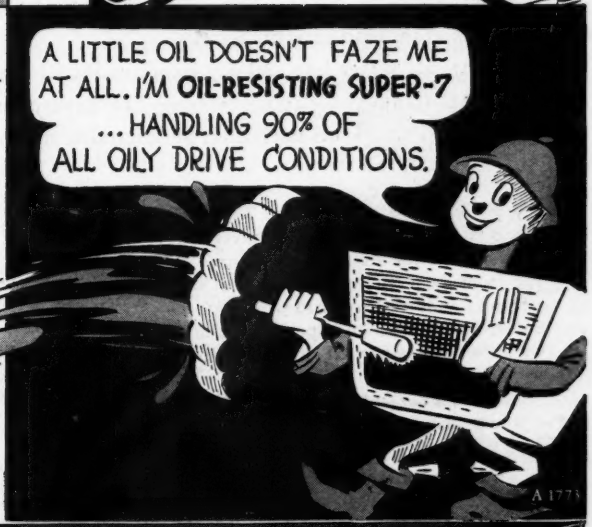


The cabinet is made of heavy sheet metal with turned-over edges and reinforced corners; welded and brazed construction; dual recessed doors hinged and arranged with specially designed stop device at half-open and full-open positions; special 2-point locking device operated with key in a manner to keep the doors secure and tight; finished in china-white Duco corrosion-resistant enamel throughout; black plastic removable lining forms ideal acid-resistant working surface.

Greatest V-Belt Show ON EARTH!

EVERY MEMBER OF ALLIS-CHALMERS GREAT NEW V-BELT TEAM IS SPECIALLY DESIGNED, TESTED AND BUILT TO LICK A SPECIFIC DRIVE PROBLEM, SAVE YOU MONEY AND TROUBLE

DON'T WORRY IF YOUR BELTS MUST PRACTICALLY BATHE IN OIL OR GREASE. JUST ASK FOR SUPER-7 OIL-PROOF. I'M MADE OF IMPERVIOUS NEOPRENE.
OIL

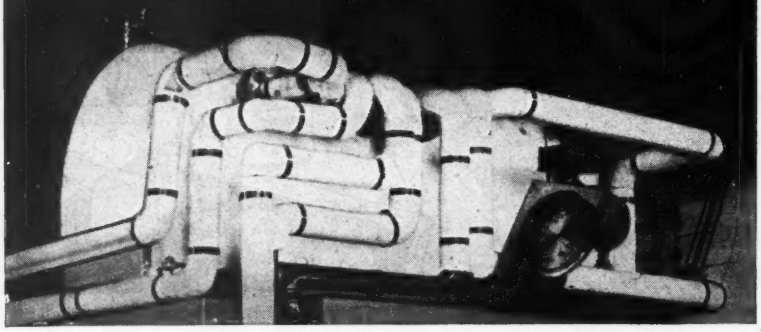


IT PAYS TO MAKE **ALLIS-CHALMERS** YOUR

V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

This STEAM DRUM *is an* UNFIRED *pressure vessel*



IN THE International-LaMont Forced Recirculation Boiler, Type LFS, the steam drum is not exposed to the fire or heated gases. No steam generating tubes are expanded into the drum. Therefore it can be located below the top of the boiler structure or supported on the wall of the boiler room, where the headroom is limited for connections to the main steam header.

Other distinctive Type LFS advantages are:

The boiler is in full circulation from zero to maximum load.

Higher efficiencies due to maximum radiant heat absorbing surface in furnace water-walls and effective arrangement of secondary heating surfaces.

Extreme flexibility—follows swinging load from no load to maximum load instantaneously.

Steady water line and dry steam under all load conditions.

Minimum space requirements—low headroom a feature.

Shop tested sub-assemblies permit quick erection on the job.

International-LaMont Boilers,* Type LFS, are designed for firing with oil, gas, pulverized coal or stokers. They are available in sizes ranging from 4,000 to 30,000 pounds of steam per hour and in all standard working pressures. Larger sizes and special pressures or superheat requirements on request.

Write today for bulletin illustrating and describing special features of this Type LFS Boiler.

*Licensed under LaMont patents.

TYPE FR 20 to 300 h.p. Shipped complete for connection to electric, fuel oil and fresh water supply lines.

TYPE LFR 20 to 100 h.p. Shipped complete for connection to electric, fuel oil and fresh water supply lines.

TYPE CR Firebox Water Tube Boiler 100-125-150 lb. A.S.M.E. Standard 10 to 300 h.p.

Also a complete line of welded firebox water tube heating boilers. 15 lb. A.S.M.E. Standards.

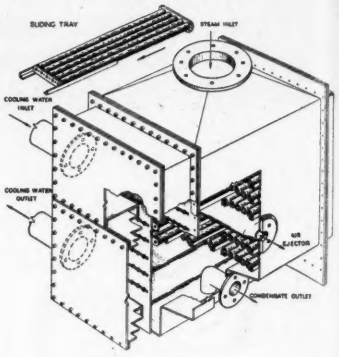
Boiler Builders for 59 Years

THE INTERNATIONAL BOILER WORKS CO.
POWER DIVISION
240 BIRCH STREET · EAST STROUDSBURG, PA.

Condenser with Extruded Surface Tubes

A NEW development in steam condenser design known as the Dawes condenser, is being introduced by Contract Engineering of San Francisco. It offers a design which not only increases capacity but enables retubing and cleaning without necessitating long shutdowns.

The Dawes condenser is compact in design and is light in weight. Tubes are of extruded surface construction. Tubes may be replaced easily and quickly, are exchanged with ease and speed because of their arrangement in trays in a file-cabinet manner. In an installation uti-



lizing a series of Dawes condensers, manifolded, a single unit may be quickly cut in or cut out. By carrying a standby unit on the manifold, the result would be no loss in power. These units may be manifolded in series to provide greater capacity as required.

The model of the Dawes condenser recently used in an exhaustive laboratory test comprised a shell 2 by 3 by 3 ft in dimension. It enclosed 314 lineal ft of extruded surface tubing. This tubing was arranged in a series of 26 trays, 5 tubes to a tray. In this test 7200 lb of steam at 266 F were condensed per hr. Water at the inlet header was 77 F. The velocity through the tubes was 6 fps and the quantity of cooling water was 3200 lb per min.

Steam Water Heater

THE NEW steam mixer water heater manufactured by the O'Brien Steam Specialty Co., 205 Harrison St., Syracuse 2, N. Y., is a complete packaged unit, including heater, temperature regulator, temperature-pressure relief valve, thermometer and steam and water pressure gages.

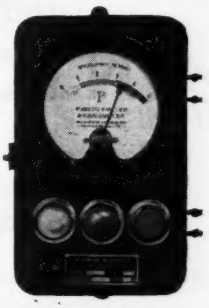
Efficient and quiet operation are secured by employing a new muffler-dif-

Too much smoke means waste — brands your plant a community nuisance. Too little may indicate an even greater loss in potential heat. You can guard against this needless waste — assure combustion efficiency — with Photoswitch Smoke Control System.

The vigilant "eye" of Photoswitch photoelectric control scans the smoke, never relaxing for a second its 24-hour watch over your fuel budget. Conditions of excess smoke, normal combustion, and excess air are thus detected *electronically* and reported to the boiler room by means of visual or audible signals, Ringelmann-calibrated meter readings, or permanent chart recordings. The result — a co-ordinated, complete system for checking overall combustion efficiency — simple, dependable and inexpensive to install and to operate.

* * *

Photoswitch is putting electronics to work — today — maintaining boiler water levels automatically . . . controlling levels in condensate return systems . . . detecting contamination in condensate . . . preventing explosions caused by flame failure . . . checking turbidity in liquids . . . timing for split-second repeat-cycle accuracy. Let us recommend the modern electronic solution to your control problem.



Your fuel supply is a share in one of America's vital war resources. Let your smoke stack show you are conserving it accordingly.

A new 8-page bulletin is available to companies interested in smoke control economy. Write to Photoswitch Incorporated, 77 Broadway, Cambridge, Massachusetts, and ask for Bulletin A-11.

Electronic Smoke Control by

PHOTOSWITCH INCORPORATED

PHOTOELECTRIC AND ELECTRONIC CONTROLS FOR EVERY INDUSTRIAL PURPOSE

Solve your drainage problems *permanently* with QUIMBY VERTICAL SUMP PUMPS

QUIMBY PUMPS

- SIMPLE DESIGN
- RUGGED CONSTRUCTION
- QUICKLY INSTALLED
- EASY TO MAINTAIN
- QUIET IN OPERATION
- DEPENDABLE IN EMERGENCIES

QUIMBY PUMP DIVISION
H. K. PORTER COMPANY, Inc.
PITTSBURGH 22, PENNSYLVANIA
Factories: NEWARK, N.J. • NEW BRUNSWICK, N.J. • PITTSBURGH, PA.
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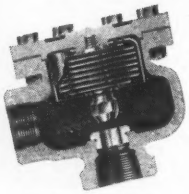
For Efficient Operation and Long Life, Specify

NICHOLSON

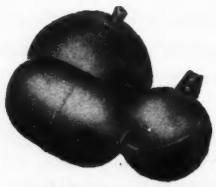


TRAPS

NICHOLSON STEAM TRAPS have the largest water and air discharging capacity of any trap in their price range. Cannot freeze, water-log or air-bind; intermittent discharge; same size valve orifice for all pressures. Sent on trial. Catalog No. 444 on request.

VALVES

NICHOLSON CONTROL VALVES are made in two, three, four-way, multi-port, metering, distributing and special types. For air, steam, oil, gas, tar or water. Also lever, foot, solenoid and motor operated types. Hydraulic pressures up to 5000 lbs. Catalog No. 543.



FLOATS

NICHOLSON WELDED FLOATS are made of stainless steel or chromium plated steel; spherical, cylindrical and elliptical shapes; sizes 2" to 14" diameter; with threaded female spud or tube through center. For pressures to 2000 lbs. Bulletin No. 339.

★

OTHER NICHOLSON PRODUCTS: Piston and Weight-Operated Steam Traps; Compressed Air and Gasoline Traps; Flexible and Compression Shaft Couplings; Expanding Mandrels; Arbor Presses; Steam Eliminators and Separators.

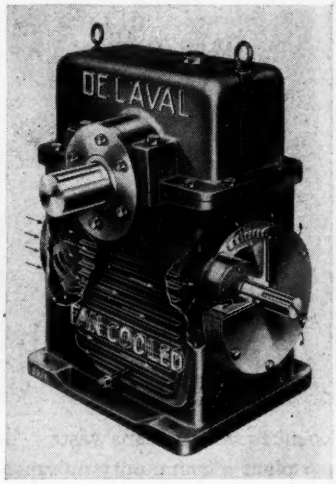
W. H. NICHOLSON & CO. 160 OREGON ST. WILKES-BARRE, PA.

fuser type mixing nozzle. Not only is all the heat of the steam delivered to the water, but the condensate itself is utilized as hot water. The unit is designed for steam pressure of 50 to 150 psi.

The heater can be easily installed near the point of use to deliver an adequate supply of hot water at controlled temperatures. Steam pipe sizes range from ½ to 1½ in., with capacities ranging up to 5500 gph. There is also a wide selection of temperature ranges available, making the unit practical as either a primary or booster heater.

Fan-Cooled Worm Gear

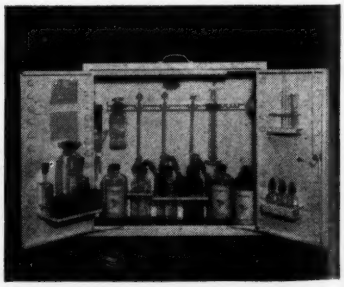
FORCED air-cooling, as employed by the De Laval Steam Turbine Co., Trenton 2, New Jersey, in the new De Laval Fan-Cooled unit, removes the heat so effectively that the capacity of the gear is doubled for practically all ratios and sizes at 1750 rpm. This permits the use of smaller, lighter and less expensive speed reducers, without sacrifice of efficiency or durability.

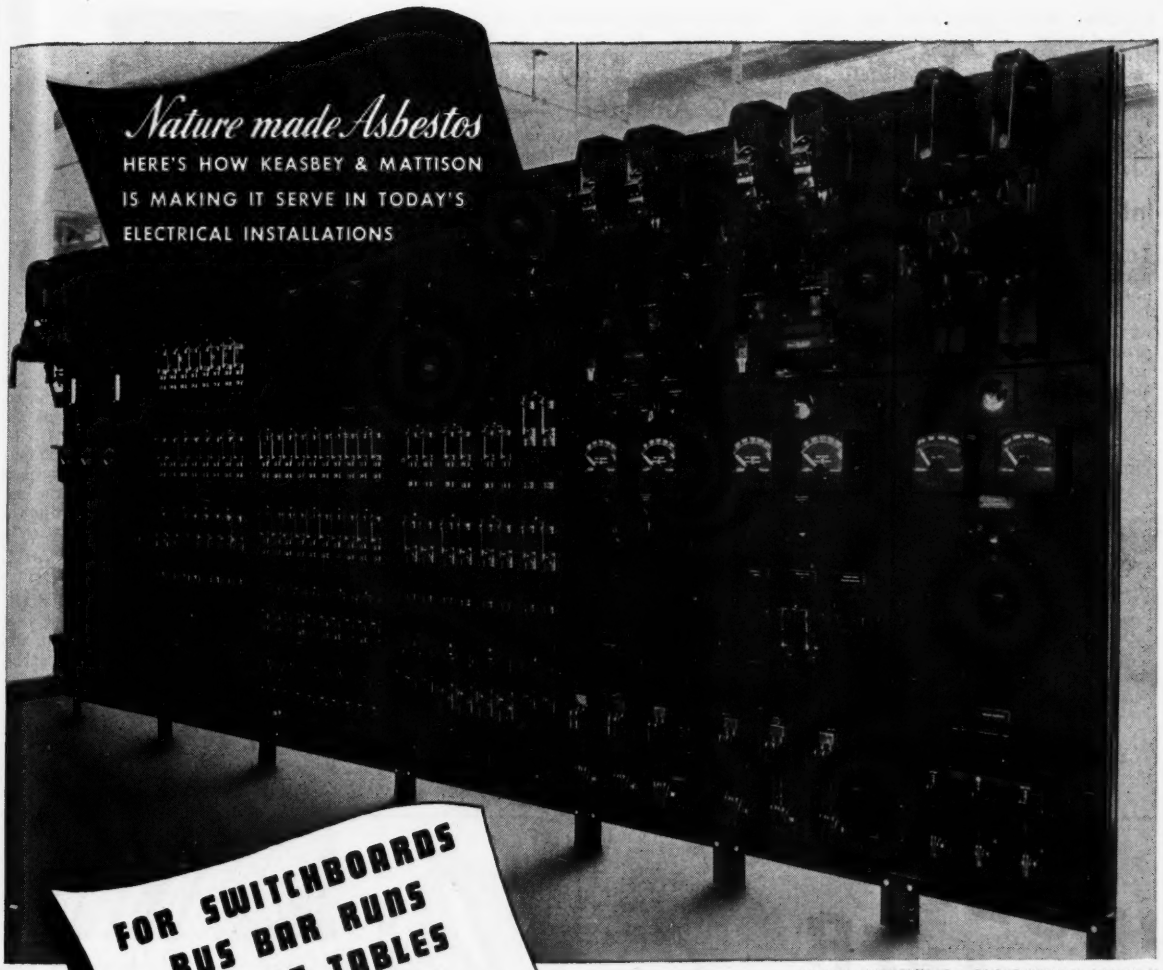


A fan mounted on the worm shaft draws air at high velocity over and around heat dissipating ribs upon the air side of the oil reservoir housing the gearing. The use of a double wall greatly increases the effectiveness of the cooling by confining the cooling air to the housing and thus securing the close air-to-metal contact necessary for maximum heat transfer. A complete line of De Laval fan-cooled worm gear speed reducers will soon be available.

Feedwater Test Cabinet

FOR TESTING boiler and feedwater samples to determine and properly regulate treatment dosage and blowdown requirements, Trutest Laboratories, Inc., Jefferson Bldg., Philadelphia 7, Pa., has designed and equipped





PHOTO—COURTESY I.T.E. CIRCUIT BREAKER COMPANY

FOR SWITCHBOARDS
BUS BAR RUNS
TESTING TABLES
PANEL BOARDS

use K&M EBONIZED ASBESTOS

Here's why! K&M Ebonized Asbestos is made especially for modern electrical insulation requirements. It consists of a perfectly proportioned combination of asbestos fibre, binding cement, insulating compound, molded under intense pressure into strong monolithic sheets.

Note these special features of K&M Ebonized Asbestos . . .

Exceptionally high dielectric strength.
Uniform density throughout.

Withstands severe shock, vibration and wide temperature variation.

Resists oil and water action.

Does not shrink, crack or bulge.

Expanded production facilities make K&M Ebonized Asbestos available for *immediate delivery*. Comes in thicknesses from 1/8" to 4", standard or special "panel" finish. Specially developed to meet technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit. For further information, write us.

KEASBEY & MATTISON
COMPANY · AMBLER · PENNSYLVANIA

a cabinet which goes under the name of Testmaster. This compact, all metal adjustable cabinet is devised to accommodate any number of or all tests, including hardness, alkalinity, chloride, phosphate, pH, Sulfite, and dissolved oxygen. It is equipped with glareless fluorescent lighting, lock and many novel and adjustable features.

Interlocked Hose

PENNSYLVANIA FLEXIBLE METALLIC TUBING Co. has developed an asbestos packed interlocked galvanized steel hose with an inside diameter of 24 in. It is reported to be the largest hose of its kind in the world. It weighs approximately 70 lb per ft and is manufactured for use principally on marine and stationary Diesels as flexible exhaust pipes, but has many other applications. Because of its interlocked construction it requires no special tools or heat to bend.

D-C Analyzer

AN ELECTRICAL testing unit recently developed by Cole Instrument Co., 1320 S. Grand Avenue, Los Angeles 15, Calif., provides in one compact, convenient, light weight case, all the ranges necessary for testing d-c motors from ½ to 600 hp and industrial and marine electrical equipment such as generating and distribution equipment or control devices.

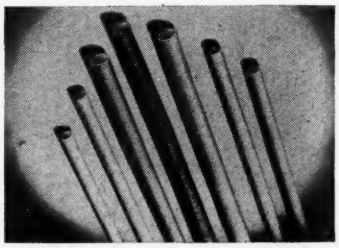
The instruments have a scale length of 3½ in. and have a self-contained range of 15-150-300-750 v with a sensitivity of 200 ohms per volt. The self-contained ampere ranges of 7.5, 75, 750 amp are

available through the heavy all-metal binding posts located at the top of the panel.

The ammeter has a separate 0-50 millivolt range which is available through external binding posts allowing the use of external shunts to provide additional ampere ranges when desired.

Glass Electrical Insulation

INTRODUCTION of the Turbo Single Saturated Glass Sleeving has just been announced by William Brand & Co., 276 Fourth Ave., New York 10, N. Y. This new insulation tubing has greater flexi-



bility than has heretofore been associated with electrical insulation of this type. It is non-moisture absorbing, nonburning and will not fray, split or crack. Any color can be supplied and all are vivid and permanent.

Heat Resisting Paint

PREPARED FOR THE protection of surfaces that attain high temperatures while in service, Triple-A High Heat Resisting Paint is marketed by Quigley Co., 527 Fifth Ave., New York 17, N. Y., for application to metals that operate at temperatures as high as 2500 F.

This paint is applied in a thin coat well brushed out, then allowed to dry from 1½ to 24 hr depending upon atmospheric conditions. For interior use, where moisture conditions are normal, the paint is then ready for service, but where extremely wet conditions prevail, it is necessary to heat the paint film after application to at least 300 F in order to produce a coating that will not be affected by moisture and render the film insoluble. For exterior use on metal surfaces the film must be heated to 500 F but for continuously hot surfaces, such as breechings, stacks and furnaces where the temperature reaches 212 F and above, no heat treatment of the paint film is necessary.

When heat treated this paint will resist water, oil, gasoline, benzol, heat and weather. It is non-inflammable and does not give off fumes when being applied.

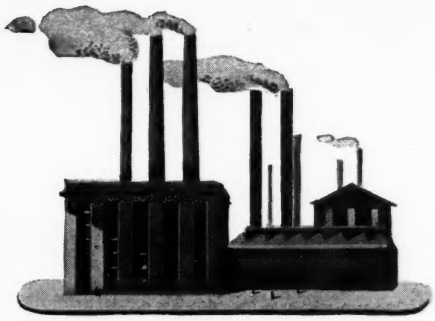
would YOU use?

Do you have some special tube-cleaning problem—scale that's hard to remove, that involves too much cleaning time—trouble in getting the cleaner around short-radius tube-bends—damage to tubes being cleaned? If you have these or any other tube-cleaning difficulties, you should get a copy of the Wilson Tube-Cleaner Selection Guide. It will help you choose and use the best cleaner for each job—to get the job done faster and more economically. It has some worth while hints on how to reduce maintenance and make cleaners last longer.

A copy of the Selection Guide—and a 36 page bulletin describing a complete line of cleaners for practically every kind of deposit in all sizes of ferrous and non-ferrous tubes—will be sent upon request and without obligation.

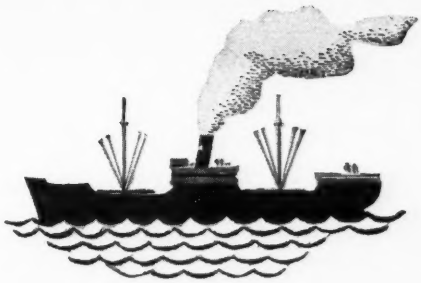
wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK



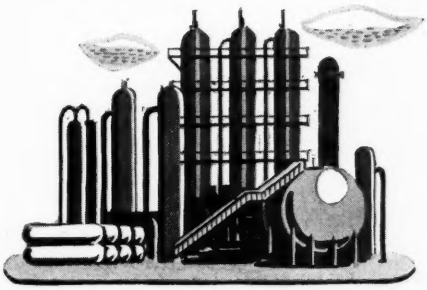
CURED BY A NOSE FOR TROUBLE

Consistent failure . . . at the same definitely-located points . . . led this power plant to apply to Scovill for help. Scovill *Service in Men* helped determine that chlorine leakage was causing the trouble. A few simple installation changes cured the trouble.



DOUBLE RIDE WITH CUPRO-NICKEL

Admiralty tubes operating in 210°F., vapor-side, lasted only 8 months. Contaminated salt to brackish circulating water invited permeable scale formation, favoring dezincification. Scovill *Service in Metals* recommended 70-30 Cupro-Nickel, lengthening service life 100%.



CONCERNING AN INFORMATION EXCHANGER

Many a refinery man, reading Scovill's Condenser Tube Booklet, has widened his knowledge of certain phases of heat exchanger tube service. Scovill *Service in Manuals* reports regularly on studies of Scovill research laboratories plus experiences of Scovill service engineers.

All three types of problems...selection of the proper metal...correct installation practice... desire for further information—are directed to Scovill because it is

One Company Which Gives You

ONE PRODUCT

. . . Condenser Tubes

THREE SERVICES

For a free copy of the new Scovill Condenser Tube Booklet, write SCOVILL MANUFACTURING CO., 17 Mill St., Waterbury 91, Conn.

OBITUARIES

Samuel W. Murphy

SAMUEL WILSON MURPHY, president of the Electric Bond and Share Co., died November 19 at his home in Orange Grove, N. J., of a heart attack. He was fifty-two years old.

Becoming president of the firm on January 23, 1941, after a long career in its legal department, Mr. Murphy presided over an economic entity whose operating subsidiaries supply electricity, gas and other utility services to areas with a population of nearly 32,000,000.

Mr. Murphy was born in Brooklyn on August 27, 1892. He was graduated in 1913 from Wesleyan University and in 1916 from the Columbia University Law School. Admitted to the bar in the latter year, he was associated first with the firm of Hornblower, Miller & Potter, and then with Geller, Rolston & Blanc.

After serving in the Navy during World War I, Mr. Murphy joined the firm of Simpson, Thacher & Bartlett. He first entered Bond & Share as an attorney in 1923, becoming general attorney from 1932 to 1934 and vice-president from 1934 to 1935. From 1935 to 1937, he was a member of the law firm of Reid & Murphy. Elected vice-president of Bond and Share again in 1937 and a director in 1938, Mr. Murphy was chosen for the presidency in 1941.

Darius E. Peck

DARIUS E. PECK since 1929 vice president and general counsel of General Electric and a member of the company's advisory committee, died December 6 at Schenectady after suffering a heart attack the day before. He was born in Hudson, New York, 67 years ago.

Mr. Peck graduated from Yale University in 1898 with a degree of B. A. He entered a law firm at Hartford, Conn., and was admitted to the bar in 1901. Following several years of private practice he joined the General Electric Law Department in 1913 and in 1920 was made assistant manager of the Law Department, progressing in 1929 to vice president and general counsel.

Jacket Cooling Water Problems
respond to
HAERING GLUCOSATES
1708
DIESELS
Locomotive or Stationary
Write for your copy of
"H-O-H Water Studies," a collection of articles on the control of corrosion, scale and algae. This 1945 edition has been enlarged to provide the latest information on Corrosion and Scale Control in Water Jacket Cooling Systems and to report a series of studies on Water Problems in Atmospheric Cooling Systems. Discussions of Steam and Return System Corrosion; Glucosates; and Proportioning Problems are also contained in this 52-page booklet.
WE READ WATER
Compressors
Gas, Air or Products Pipe Line
D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Ill.

MANUFACTURERS' NEWS

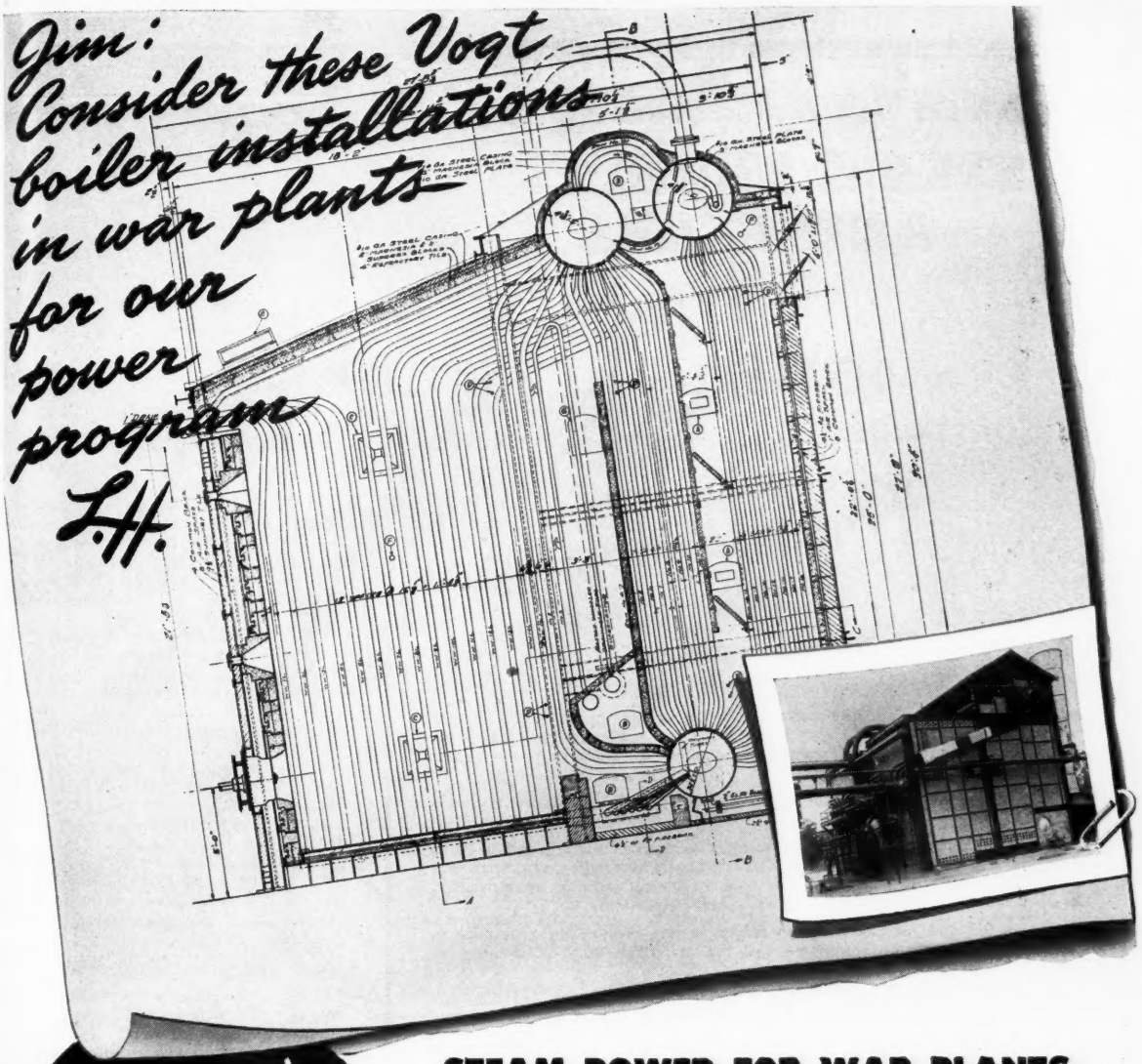
Announcement has been made by the Board of Directors that Kenneth McCreary has been elected President of the Goetze Gasket & Packing Co., Inc., New Brunswick, N. J. Mr. McCreary has been associated with this company since 1932, and has served consecutively as assistant to the President, Treasurer, and Vice-President and Treasurer. He succeeds the late Frederick Goetze, who died on January 30, 1944. At the board meeting Mr. McCreary outlined ambitious postwar plans for his company which is now devoted almost exclusively to products used by the Armed Forces.

M. W. Kellogg Co. has recently announced that Paul Ryan has been elected Vice-President of the Company. Mr. Ryan was formerly President of the National Refining Co., of Cleveland, and more recently with the Petroleum Industry War Council at Washington.

Establishment of the Rucker-Vaughn Co. is the result of a merger of two well known Oakland firms, namely, G. E. Witt Co. and the Rucker Equipment Co. Headquarters are established at 300 17th Street in Oakland and the factory is in Emeryville. Co-partners of the company are Clark E. Rucker, in charge of sales and Clifford S. Vaughn in charge of production. The company manufactures a complete line of standard pressure valves, steam and air atomizing oil burners, a special compressed air line lubricator, and is sales agents for a representative group of compressed air and production tools.

Frank Gawan has recently joined the staff of Joy & Cox, Denver, Colo., which concern represents a number of nationally known manufacturers of power equipment. Mr. Gawan is the designer of combustion and control instruments and is well versed in the application of this type of equipment. He was formerly connected with the Denver Fire Clay Co. in their Salt Lake City and Denver offices.

Allan Dale has recently been elected Vice-President of the Shook Bronze Corp. of Lima, Ohio. Mr. Dale has had many years of experience in the manufacture and sales of bearing metals and bushings, and will be in charge of the company's sales of finished products along these lines.

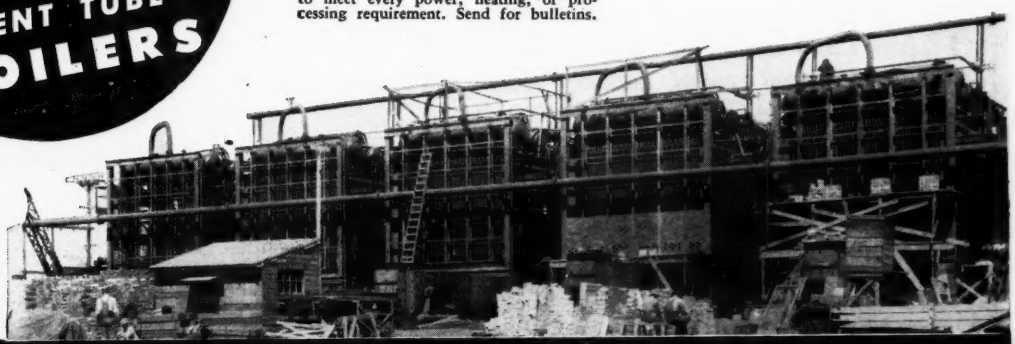


Vogt
CLASS VR
BENT TUBE
BOILERS

STEAM POWER FOR WAR PLANTS

These Oil and Gas Fired Steam Generators are working round-the-clock in war plants producing 100 octane gasoline and synthetic rubber components . . . all vital to Victory!

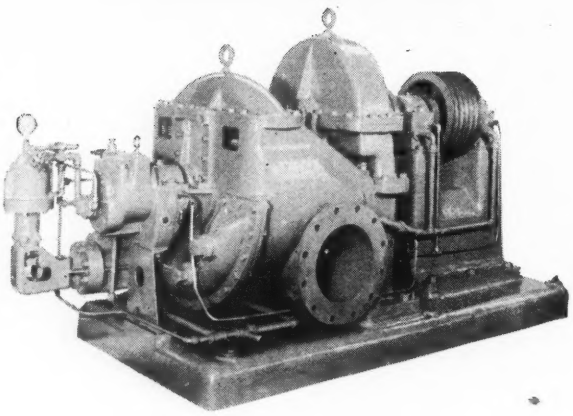
Vogt builds steam generating equipment to meet every power, heating, or processing requirement. Send for bulletins.



HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY

Branch Offices: New York - Chicago - Cleveland - Philadelphia - Dallas

MURRAY
STEAM TURBINES AND GEARS



In the smaller sizes, MURRAY recommends the use of the Type UG integral turbine-gear unit, for lowest steam consumption and moderate cost. Unless the slow speed apparatus to be driven is for standby operation only, the geared set will pay for itself in a short time.

Compare its steam rate with that obtained by using a direct connected turbine.

Correct alignment of the gear and turbine bearings is assured, and is easily maintained, since expansion of the exhaust casing is allowed by machined pads and bolts, located at the center-line, holding the turbine and gear casings, together with the sliding dowel, which allows expansion.

The pinion and turbine shaft are forged in one piece. The gear may be solid forged, or built-up, using a forged rim and cast center. Depending on face width, the gears are single or double helical.

The unit shown is equipped with direct-acting variable speed governor, and drives a reciprocating ammonia compressor in an eastern food processing plant.

For turbines from 10 horsepower to 2500 kilowatts rating—refer to our nearest representative.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

TEMPLETON RETURN STEAM TRAPS

for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

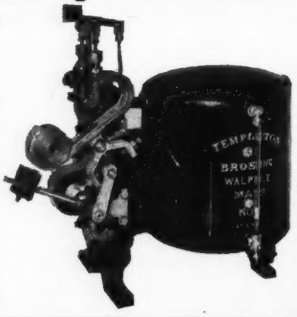
Pumps Water at any temperature or pressure

Open float cannot burst or waterlog

Valves and Seat Bronze or Stainless Steel

Sizes 1 in. to 4 in. inlet and outlet

Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



Ask for catalogue and prices

TEMPLETON BROS., INC.

699 Main St. Walpole, Mass.

Fisher Governor Co., Marshalltown, Iowa, has recently announced the appointment of Malcolm W. Black & Co., as its representative in New York and surrounding territory including Connecticut and Northern New Jersey. Offices have been established at 41 East 42nd Street, New York City.

Globe Steel Tubes Co., of Milwaukee, has announced the appointment of Frederick K. Krell as advertising manager, whose headquarters will be the General Sales Office of the Company. Mr. Krell is the immediate past president of the Milwaukee Junior Chamber of Commerce, and is at present chairman of the Trade Promotion Committee of the U. S. Junior Chamber of Commerce and State Director of the Wisconsin Junior Chamber of Commerce.

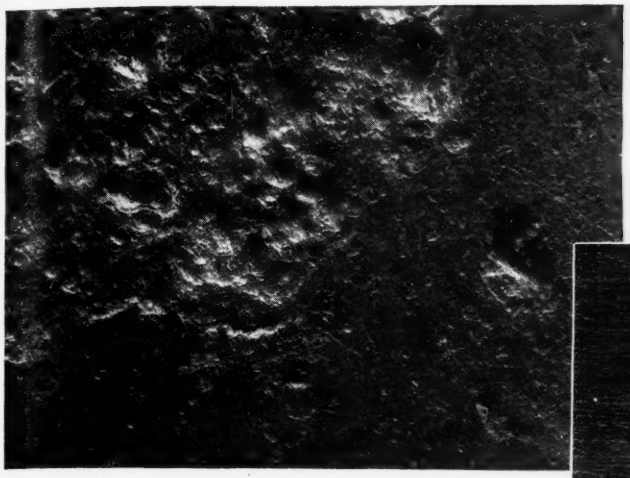
Westinghouse Electric & Mfg. Co. has recently announced the election to its Board of Directors of Harry B. Higgins, President of the Pittsburgh Plate Glass Co. Mr. Higgins is also President and a director of the Pittsburgh Corning Corp., and a director of the Mellon National Bank and of the A. M. Byers Co., and a trustee of the University of Pittsburgh, the Magee Hospital, Pittsburgh, and the Dollar Savings Bank of Pittsburgh.

John Blake has been appointed by the United States Rubber Co., as manager of marine cable sales, with headquarters at 1230 Sixth Avenue, New York City. Mr. Blake started with the company during 1911 at the Bristol, Rhode Island, plant. He left the employ of the company during 1915 but returned to Bristol as subcontracting manager during recent years.

After 48 years of service with Standard Oil Co. (Indiana), Amos Ball, vice president in charge of sales and a director, retired on January 1, 1945. With Mr. Ball's retirement comes many promotions in the sales managerial organization of the company. Roy F. McConnell, now general manager of sales, will move into the vice presidency, and H. E. Hanson, now ranking assistant general manager, will become the general manager of sales. R. F. Baity, assistant general manager for the central division, will take Mr. Hanson's place. J. W. Honomichl, now manager of the company's Des Moines, Iowa, sales division, will go to Chicago as an assistant gentral manager of sales for the central division. His place will be filled by R. T. Kinneman, now manager at La Crosse, Wisconsin. D. J. Byers, assistant manager at St Louis, Missouri, will be promoted to manager at La Crosse, and H. L. Poole, a sales promoter on the general office staff, will go to St. Louis as an assistant manager. In connection with the changes the title of L. C. Welch, will be changed from that of manager to General Manager lubricating and sales technical service departments.

On December 9, 1944, The McClave Co. cancelled its sales agency agreement with the Automatic Coal Burner Co. of Philadelphia, Pa., and has reopened its Philadelphia office at 1600 Arch Street, which will be in charge of E. C. Sholler as representative in the Middle Atlantic district.

The Busch-Sulzer Bros.—Diesel Engine Company, St. Louis announces the appointment of Joseph G. Broz as Vice-President in charge of sales and of Charles E. Beck as Sales Manager.



This May Be Extreme, But It May Happen Within A Short Time In Any Boiler

This Apexiorized Metal Has Not Been Affected By Boiler Water During the Past 15 Years

That smooth, brush-marked surface is APEXIORIZED metal. The thin, but tough, durable APEXIOR coating has added years of life to the metal.

APEXIOR keeps metal young by providing an effective and long-lasting barrier against water and corrosion. It retards scale formation, lengthening the periods between cleaning and making scale removal easier. Operating efficiency is thus improved and manpower conserved.

Boiler Insurance — Brush-Applied

APEXIOR NUMBER 1 is a water and steam resistant paint, purposely developed to provide a protective coating for steel and iron. It is not affected by high temperatures, high pressures or ratings, by chemical treatment of boiler water or by varying feedwater conditions. It does not retard heat transfer.

The thickness of two coats of APEXIOR NUMBER 1 is only about .0025", yet one application lasts 2 to 3 years or more. It is easily renewed.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many manufacturers of turbines coat their shafts, rotor bodies, and frequently interiors of casings with APEXIOR before shipping to customers.

Let us give you more facts. Use the coupon below. The Dampney Company of America, *Main Office* Hyde Park, Boston, Mass. *Branch Offices,* Atlanta, Chicago, New York, Detroit, Philadelphia. *Engineering Sales Representatives*—Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B.C., Montreal, P. Q., Havana, Cuba, Honolulu, T. H. *Marine Dept.,* 114 Liberty Street, New York, N. Y.

For "Cold-Wet" Metal Surfaces— APEXIOR No. 3

Wherever you have tanks or metal surfaces exposed to water or moisture at any temperature under 125°F.—protect them with APEXIOR NUMBER 3. This special, shiny black paint on metal is highly resistant to cold water, fresh or salt.

Organizations like these have used APEXIOR for years

Aluminum Co. of America
Boston Edison Co.
Lever Bros. Co.
Swift & Co.
Truscon Steel Co.
Goodyear Tire & Rubber Co.
Standard Oil Co. of N.J.
Virginia Railway
Delaware Power & Light Co.

APEXIOR

Keeps new metal new . . . Gives old metal new life

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

Name.....

Company.....

Address.....

Don't risk damage to tube cleaners and hose

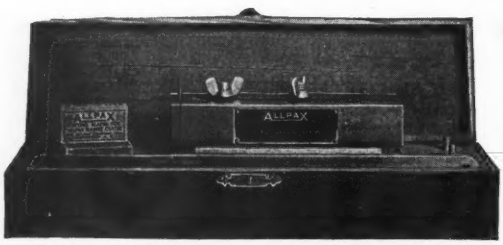
Kinking tube cleaner hose to shut off air is poor practice at any time, especially now, when hose is a critical material. Besides ruining the hose, small hose particles may peel off and clog the motor.

Why risk damage to tube cleaners and hose by kinking the hose to control the air. A Roto Operating Air Valve attached to the tube cleaner motor, enables the operator to control the air safely, entirely by himself. This inexpensive valve speeds up tube cleaning and releases a helper for other work. Our complete line of modern, efficient tube cleaners will meet practically every requirement. Write.

The ROTO Company

145 Sussex Ave., Newark, N. J.

A DIVISION OF ELLIOTT COMPANY



Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere ***Mamaroneck, N. Y.***

MANUFACTURERS' PERSONALS

P. S. Dickey has recently been appointed Chief Engineer of the Bailey Meter Co., Cleveland, Ohio. Mr. Dickey will supervise all engineering, research and design activities of the Company, and will be assisted by H. H. Gorrie, Assistant Chief Engineer, and R. E. Clark, Manager of Contract Engineering.

Recent appointments made by the Brown Instrument Co. include that of O. B. Wilson as New York industrial manager, precision industrial instrument division, Minneapolis-Honeywell Regulator Co.; and J. A. Robinson, industrial manager of the Chicago branch.

Edward Stanley D'Arcy has just been appointed to the staff of the Dominion Flow Meter Co., Ltd., Toronto, and has undergone a two weeks' intensive course in boiler water conditioning technique at the home office of Hagan Corp. and Hall Laboratories. The Dominion Flow Meter Co. bases its water conditioning procedure practice on the researches of Dr. R. E. Hall of Hall Laboratories.

The Reliance Electric & Engineering Co., Cleveland, Ohio, has announced the appointment of Edward E. Helm as general sales manager of the company. Mr. Helm has been district sales manager in Philadelphia for the company. Kenneth S. Lord will succeed Mr. Helm as manager of the Philadelphia district.

Clarence F. Jensky has recently been appointed to head a newly created turbine sales division of the Joshua Hendy Iron Works, Sunnyvale, Calif. Mr. Jensky has been actively engaged in steam-turbine design and engineering for many years including service with Westinghouse and Murray Iron Works.

American District Steam Co., North Tonawanda, N. Y., has recently appointed the General Meters & Controls Co., 205 West Wacker Drive, Chicago 6, Ill., as District Representative for the Northeastern Illinois and Northwestern Indiana territory.

Blackmer Pump Co., Grand Rapids, Michigan, has announced the appointment of Fred T. Kennedy as General Manager of the company. Until recently, Mr. Kennedy has been connected with the War Production Board in Washington.

NEWS FROM THE FIELD

New Unit for Detroit Edison

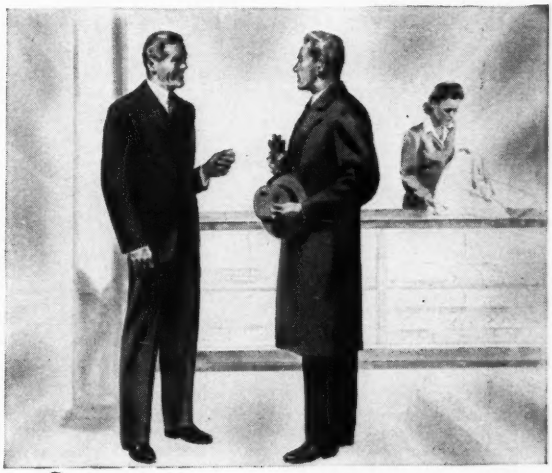
DETROIT EDISON COMPANY has plans set to spend $125,000,000 during the ten years after the war to keep pace with demands for electricity in the Detroit area, James W. Parker, president and general manager, has just announced.

Parker disclosed that a new 75,000-kw turbo-generator is on order, now held up for many months by the urgent need of critical materials for war industries. "This will be one of the first items of post-war construction we shall do the

1. *A business man asks . . .*

2. *A professional man inquires . . .*

3. *An architect wonders . . .*



4. *A department store manager asks . .*

Does OTIS still make elevators?

Certainly! We've never been *out* of the elevator business, although our engineering and manufacturing facilities have been working 100% for the Armed Services.

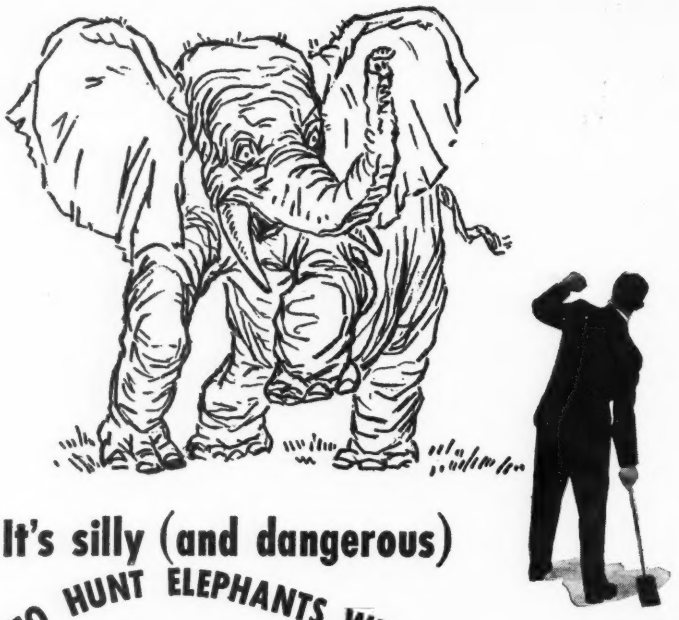
It is true that we have manufactured vast quantities of parts for guns, ships and aircraft for the Army, Navy and Air Corps but, because vertical transportation is essential in the production and handling of munitions of war and in the operation of aircraft carriers, we have continued to produce a large volume of passenger, freight and special purpose elevators.

We have been too busy producing war goods to say much about the future — but

Now — representatives in our 244 offices are ready and waiting to work with architects, engineers, and owners in the preparation of surveys, plans and estimates on new elevator installations or the modernization, repair or maintenance of existing facilities.

Your action now will expedite future deliveries. Production will begin as soon as material and labor are no longer required for war goods.

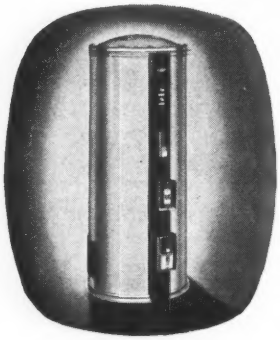
Otis ELEVATOR COMPANY
BRANCH OFFICES IN ALL PRINCIPAL CITIES



It's silly (and dangerous)

TO HUNT ELEPHANTS WITH A FLY-SWATTER

. . . *but* it's no more silly (or dangerous) than hanging a "tin can strainer" on a Diesel Engine with the hope of removing destructive contamination from lubricating oil.



To Get Results You *Must* Have an *Oil Purifier With Capacity!*

Capacity to remove all abrasives, sludges, acids and destructive contamination.

Capacity to remove this contamination as fast as it is liberated by the operation of the engine.

Honan-Crane "Continuous" Oil Purifiers *Have Capacity.*

CAPACITY to remove all abrasives, acids, sludges and other types of non-lubricating contamination.

CAPACITY to keep oil "continuously" clean. According to model sizes, single refills will remove from 6½ to 900 pounds of dangerous contamination.

Does Your Oil Purification Equipment have the *Capacity* to *do the job?*

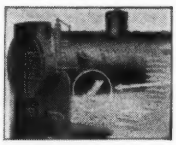
HONAN-CRANE CORP.
Subsidiary of Houdaille-Hershey Corp.
301 Indianapolis Ave. Lebanon, Ind.

WRITE FOR ENGINEERING BULLETINS AND COMPLETE DATA ON THE PURIFICATION OF ANY KIND OF FUEL OR LUBE OILS.

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.



You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

moment the demands of the war permit," Parker said.

"Pent-up demand for automobiles and the power needs of the many new war industries which will continue in Detroit after the war; growth in the use of present and new electrical appliances, better home and industrial lighting; growth in population in our territory; and high frequency induction heating for industries are factors which make us feel optimistic on a basis of factual studies."

Liquid Fuels Research Laboratory

PLANS FOR the construction of a synthetic liquid fuels research and development laboratory by the Bureau of Mines at Bruceton, Pa., south of Pittsburgh, have been announced. The various structures comprising the large laboratory should be ready for occupancy by the fall of 1945. The various units in the laboratory and other facilities will occupy about seven acres and will include three large buildings, each three stories high, a power house, and several smaller service buildings.

This latest development in the Bureau of Mines research program to be known officially as the Research and Development Laboratory for Synthetic Liquid Fuels, and should not be confused with demonstration plants and, second to improve the methods of producing gasoline and other valuable products from coal.

It will serve two purposes: The first to reduce the cost of constructing the larger-size demonstration plants and, second, to improve the methods of producing liquid fuels from coal so that the demonstration plants will be the most modern that can be built and operated.

The extensive laboratory facilities at Bruceton will be used to develop improved techniques over those now employed in England and Germany. Plans made include demonstration plants to be built later that will embody the new and improved methods worked out in the Bruceton laboratory.

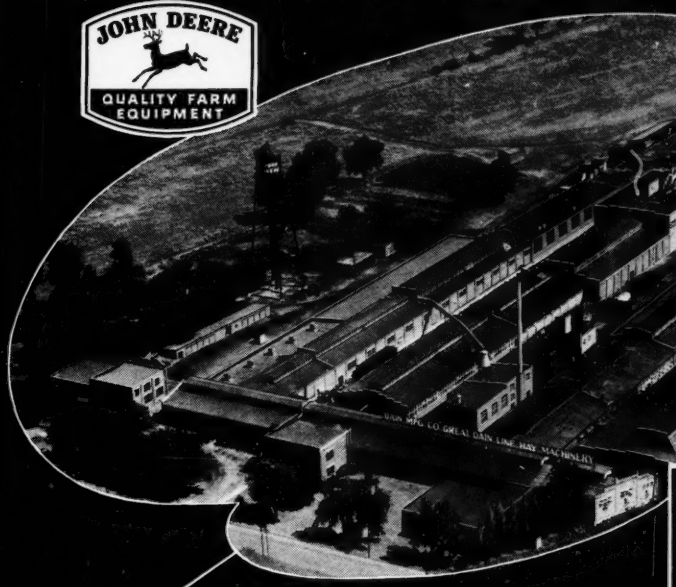
Midwest Power Conference

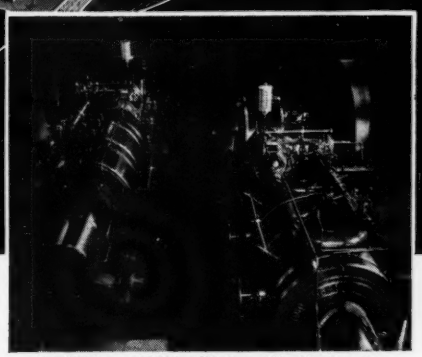
"TO VICTORY AND POST-WAR PROSPERITY WITH POWER" is the theme of the eighth annual meeting of the Midwest Power Conference to be held April 9 and 10, 1945, at the Palmer House in Chicago. The Conference is sponsored by Illinois Institute of Technology, where Stanton E. Winston, conference director, is associate director of the mechanical engineering department.

Nine colleges and universities and several engineering societies are co-operating agencies. A session on the gas turbine will be included in the program for the first time. Other sessions being planned will deal with industrial power plants, feedwater treatment, recent developments in heating, recent developments in air conditioning, fuels and combustion, central station practice, post-war load planning, Diesel power, and hydro power.

Three electrical sessions, the all engineers' dinner, and the joint luncheons with the American Society of Mechanical Engineers and the American Institute of Electrical Engineers complete the preliminary program.

• FROM JOHN DEERE'S ANVIL GREW 14 GREAT FACTORIES





SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES Generate Electric Power in 7 of These Plants

The 300-kw. and 350-kw. "Universal Unaflow" engine-generator units in the Dain Manufacturing Company plant of Deere & Company, Ottumwa, Iowa.

FROM Vermont in 1836 a Yankee started west, carrying with him a small bundle of tools and a much smaller bundle of cash. But John Deere also carried with him a thorough mastery of the mechanic and blacksmith trades, as well as inventive genius and breadth of vision.

In the waxy, black soil of the prairies that stuck to the old-fashioned iron plows, John Deere found his opportunity. He believed that steel was the answer—and proved it. His plow, fashioned from a broken saw blade salvaged from a neighboring sawmill, was an immediate success and became known as "John Deere's Self-Polisher."

From this small beginning, over a hundred years ago, the House of Deere has been inseparably linked with agricultural equipment, such as plows, corn and cotton planters, hay machinery and scores of other items in its complete line of farm implements.

Skinner Engine Company is proud of its long and happy association with Deere & Company. Economical, dependable power is being generated in seven Deere plants by nine Skinner "Universal Unaflow" Steam Engines—with efficient use of the exhaust steam for heating and processing. This is not an unusual example, for in practically every type of industry savings are being made where far-sighted management is using Skinner engines for electric power generation. It will pay you to investigate the possibility of substantial savings in your own business. Case studies pertaining to your particular industry will be sent upon request.

Do More Than Before—Buy EXTRA War Bonds

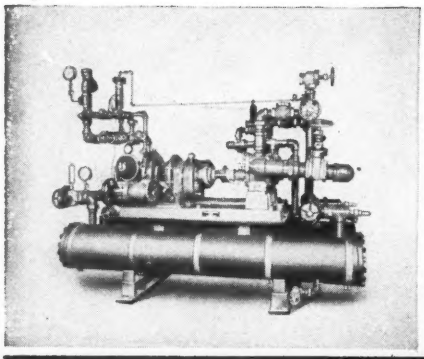
For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

YOUR Enco designed to meet your conditions

OIL PUMPING AND HEATING UNIT

It is made to suit your specific individual needs. With one pump and one heater or duplicate pumps and heaters with full capacity from each. Using steam or electric power. Having all of the many features you should have for safety, accessibility of controls, and ease in making adjustments, servicing and cleaning. Capacities from 100 to 5000 G.P.H.

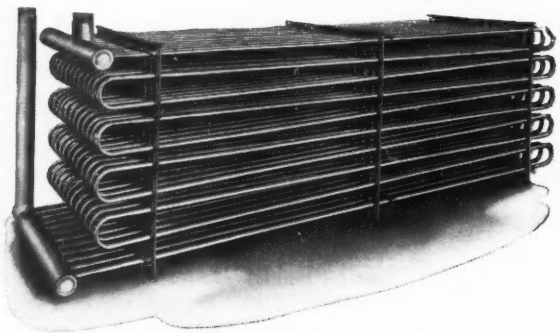


FREE

Bulletins on request; OB37 on Oil Burning, Pumping and Heating Equipment; OB38 Instruction Book on care and operation of oil burner installations.

THE ENGINEER COMPANY
75 WEST STREET Enco NEW YORK 6, N. Y.

Another Heat Reclaiming Unit from Rempe



Copper Coils Welded into 4 In. Headers

UNIT is all copper including the headers and is 24 feet in length. Used for pre-heating processing water by submersion in concrete pit through which waste hot water is pumped . . . Rempe Coils and Bends are made from any material to customer's specifications. Write us about your needs.

REMPE CO.
342 No. Sacramento Blvd., Chicago

Edison Medal to Alexanderson

THE EDISON MEDAL for 1944 has been awarded by the American Institute of Electrical Engineers to Doctor Ernst Fredrik Werner Alexanderson, consulting engineer, General Electric Co., "For his outstanding inventions and developments in the radio, transportation, and power fields."

The Medal will be presented to Dr. Alexanderson on Wednesday evening, January 24, 1945, during the Winter Technical Meeting of the AIEE. The presentation will be made in a joint session with the Institute of Radio Engineers.

The Edison Medal was founded by associates and friends of Thomas A. Edison, and is awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by a committee composed of 24 members of the AIEE.

Research Sponsored by ASRE

THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS launched a program of research November 1, when four well-known institutions engaged in refrigeration education and research each received a grant of $500 from the Society.

The distribution of research grants made at this time, is as follows: Massachusetts Institute of Technology: "The investigation of various calorimeters used in refrigeration test work in order to propose a standard calorimetric procedure for testing of small and moderate sized refrigeration compressors."

Case School of Applied Science: "Pressure Drop in Freon Evaporators."

Oregon State College: This research is to be known as Project No. 53. The project is a continuation and refinement of one of which some work has already been done. The object is to determine values of film coefficient of heat transfer from metal surfaces to boiling ammonia in a flooded evaporator.

University of Texas: "Developing Methods of Preserving Fish Beginning with the Time It Is First Caught." Studies will be made of the effects of time of freezing respective to the catch, freezing temperature, storage temperature, time in storage, kinds of fish, methods of freezing. Effort will be made to develop means of freezing the catch as brought on board the fishing boat.

The ASRE Council has also approved similar grants to the University of Illinois and the University of Tennessee; details of the projects covered will be announced later.

New Officers for ASRE

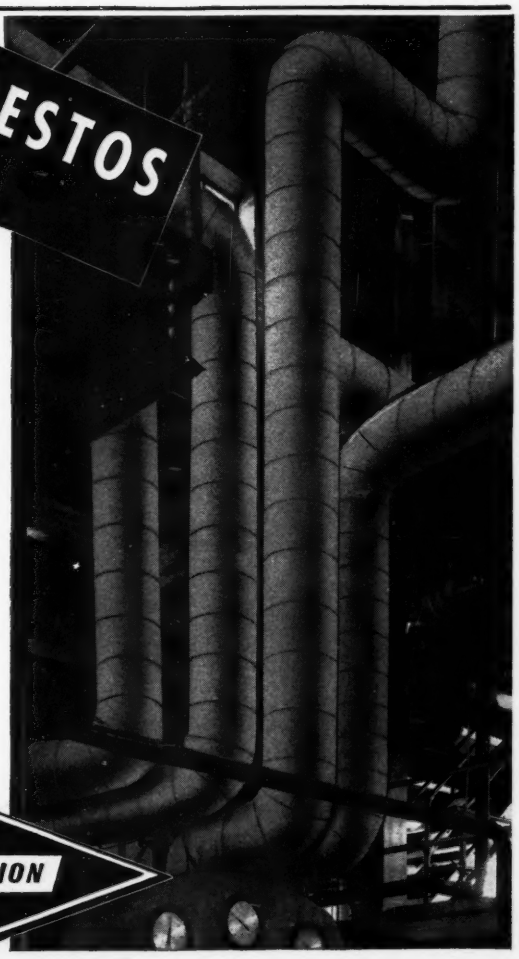
AT THE CLOSE of its 40th Annual Meeting held December 10-13 in New York City, The American Society of Refrigerating Engineers announced the following officers of the Association for the coming year:

President, J. F. Stone, Johns-Manville Corp., New York; Vice President, Charles S. Leopold, consulting engineer, Philadelphia, Pa.; Vice President, Roland H. Money, The Crosley Cor-

COMING OUT AT THE ELBOWS?

SIMPLY APPLY UNIBESTOS
it's simple to apply!

Unibestos, being sectional for virtually all size pipes, greatly simplifies the application of insulation to bends and elbows. You simply mitre sectional Unibestos to fit—the fibrous nature of the material used in Unibestos (amosite) makes for a more perfect seal; eliminates much of the need for filling in with plastic —requires only a *surface* application to finish it off in a neat, clean and efficient job.



UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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UNION ASBESTOS AND RUBBER CO

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

DO YOUR RECIPROCATING PUMPS RACE ALL DAY?

SLOW 'EM DOWN
SAVE STEAM WITH **COMBINATION**
NON-TILT, NON-SLIP VALVES

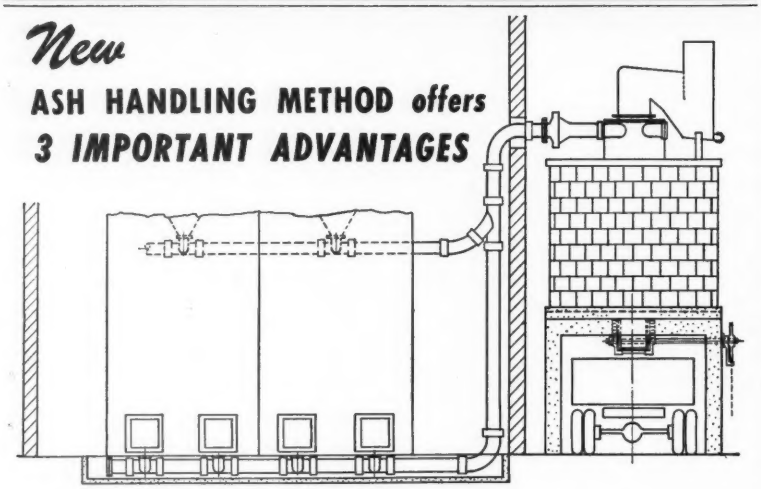
**For Boiler Feed
Vacuum, Condenser
General Service**

THE tilting action of some reciprocating pump valves permits the seat to wear unevenly—means the pump has to operate faster and waste steam to carry its theoretical load.

COMBINATION Pump Valves slow down and help save steam because they are built especially to prevent tilting and consequent slippage. Seat, stud and spring are made of long-lasting Phosphor Bronze. They match the fine performance of COMBINATION Silent Check Valves. Ask for descriptive folder with dimensions, prices and further details.

COMBINATION PUMP VALVE CO.
846 Wiota Street, Philadelphia, Pa.

New
ASH HANDLING METHOD *offers*
3 IMPORTANT ADVANTAGES



In the Beaumont "Vac-Veyor" pneumatic ash handling system the exhauster, receiver, separator and air washer are combined as one unit. Operating advantages include: (1) All ash delivered into the silo, none into the air. (2) Ashes delivered practically dry, which minimizes the possibility of packing or freezing in the silo. (3) Continuous operation, with low steam consumption. What are your ash handling problems? Send today for literature.

BEAUMONT BIRCH COMPANY
1503 RACE STREET . PHILADELPHIA, PA.
DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

poration, Cincinnati, Ohio; Treasurer, John G. Bergdoll, Jr., York Corp., York, Pa.; Directors (for three years), B. H. Jennings, Northwestern University, Evanston, Ill.; Charles S. Neeson, Airtemp Division, Chrysler Corp., Dayton, Ohio; John S. Forbes, Superior Valve and Fittings Co., Pittsburgh, Pa.; Warren W. Farr, Refrigeration Maintenance Corp., Cleveland, Ohio; and C. Hill Garrison, C. H. Garrison Co., Kansas City, Mo.

New Officers of the DEMA

AT ITS Annual Meeting December 6, 1944, in Cleveland, Ohio, the Diesel Engine Manufacturers Association announced the re-election of Robert E. Friend, president of Nordberg Mfg. Co., as President of the Association. Announcement was also made of the election of F. H. Kilberry of the Atlas Imperial Diesel Engine Co.; and E. J. Schwanhausser, of Worthington Pump & Machinery Corp., as Vice President. Robert H. Morse, Jr., Fairbanks, Morse & Co., was re-elected Treasurer, and Harvey T. Hill will continue as executive director.

Four new directors named are Norris H. Schwenk, Busch-Sulzer Bros. Diesel Engine Co.; Charles E. Brinley, Baldwin Locomotive Works; Charles G. Cox, Enterprise Engine & Foundry Co., and F. H. Kilberry.

ASA Officers for 1945

AT ITS Annual Meeting held in the Hotel Roosevelt in New York City the American Standards Association announced the following officers for the Association during 1945: Henry B. Bryans, President (re-elected), of the Philadelphia Electric Co.; Vice-President, George S. Case, Lamson and Sessions Company (re-elected); Chairman, Standards Council, H. S. Osborne, American Telephone and Telegraph Co. (re-elected); and Vice-Chairman, Standards Council, E. C. Crittenden, National Bureau of Standards (re-elected).

Sill & Warrington, Engineers, announces the new location of their offices at 79 Milk Street, Boston 9, Mass.

E. R. Fish has announced his retirement from The Hartford Steam Boiler Inspection and Insurance Company as of November 1, 1944, and also from chairmanship of The Boiler Code Committee of the ASME of which he has been a member since 1918 and Chairman for the past three years. The date of the latter retirement is December 1, 1944.

Ralph D. Thomas and Associates, Consulting Engineers, Minneapolis, Minn., have recently announced the association with them of Carl W. Frank, Civil Engineer; L. J. Neubauer, Mechanical Engineer, R. C. DeWahl, Electrical Engineer, also, the firm of Long and Thorshov, Inc., Associate Architects.

The American Iron and Steel Institute has reported that during the first three years of World War II, from December 8, 1941, through December 7, 1944, the steel plants of the United States produced a record-breaking total of more than 263,000,000 tons of steel ingots and castings. That total is nearly 80 per cent more than produced in the three best years of the first World War, and exceeds by nearly 55 per cent the maximum tonnage produced in any three-year period of peacetime.

AN *Airtight* ENCLOSURE

A bubble is nature's perfect air-tight enclosure having a skin through which no air can pass. Of course we wouldn't try to enclose heat in a bubble but Detrick engineers have employed the principle of an air-tight skin in their furnace enclosures.

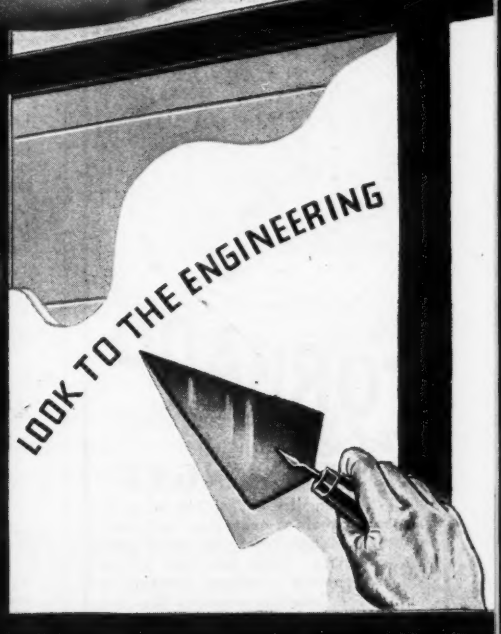
This skin is in the form of a plastic outer casing applied with a trowel to the back of the insulation and keyed in position in small panels by the refractory supporting members. Such a casing completes the furnace enclosure and provides a neat, weatherproof covering. Since it is applied directly to the back of the insulation which itself is laid against the back of the refractory, there is no opportunity for blind leaks to develop.

This is another example of the type of Detrick engineering which has enabled this organization to render outstanding service to thousands of America's leading industrial concerns.

If your present or post-war plans include new furnaces or modernization of old equipment, our engineers would like to have the opportunity of making suggestions. Send your blueprints in and ask for a copy of the new book DETRICK FURNACE ENCLOSURES which brings you up to date on this important subject.

M. H. DETRICK COMPANY

111 West Washington Street Chicago 2, Ill.

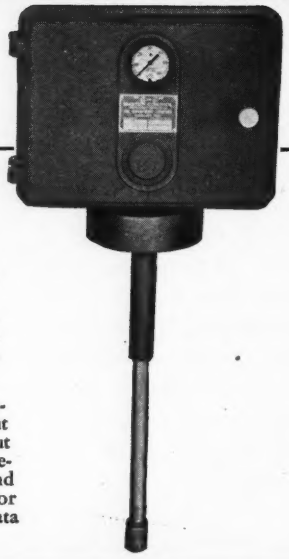


DETRICK FURNACE ENCLOSURES

USE DETRICK INSULATION . . . *PLASTIC or BLOCK*

New PRECISION temperature control by Swartwout

Meets your most critical demands—assures constantly accurate regulation . . . . .



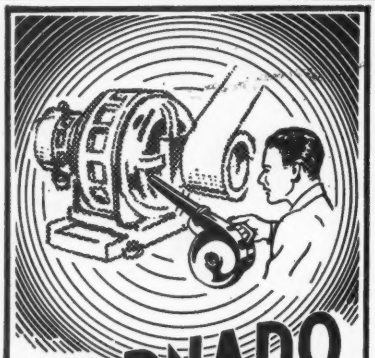
● Especially designed for maintaining temperatures where accuracy and dependability are of utmost importance, this new Swartwout Thermo Master Control combines unusual sensitivity with the rugged construction which characterizes Swartwout Equipment.

Used on temperatures of 50° to 950°—at any pressure—in steam desuperheating and other process requirements involving vapors and fluids.

Type T-1 Thermo Master Control reflects the thoroughness of Swartwout engineering—benefits by long Swartwout experience in providing complete reducing and desuperheating stations and a wide range of power controls. For more complete details, write for Data Unit No. S-197.

Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio



TORNADO PORTABLE ELECTRIC BLOWER

reduces **DUST DANGER**

BLOWS clean, dry air, at 295 m. p. h. Cleans out motors, generators and hard-to-get-at places — removing dust, dirt, lint and chips. Costs less than 3c. an hour to operate. Reduces damage to motors and bearings — lessens fire and health hazards.

1 H. P. universal G. E. motor. Weight, 14 lbs. Portable to any place in plant. Plugs in at convenient outlets. Adaptable as Sprayer for spraying paint and insecticide. Convertible into powerful industrial Vacuum Cleaner—for cleaning floors, walls, ceilings, etc.

Free Trial—Write to

BREUER ELECTRIC MFG. CO.
5108 N. Ravenswood Ave., Chicago

TAKE THE DUST OUT OF DUSTRY

TORNADO
PORTABLE ELECTRIC BLOWER

LaMOTTE BOILER FEED WATER TEST UNITS

The LaMotte Research Department has developed a reliable series of chemical tests for boiler feed water control of the following constituents:

Phosphates	**Dissolved Oxygen**
Chlorides	**Sulfates**
Total Alkalinity	**Hardness**

pH (Hydrogen-Ion Concentration)

For positive control of efficient water treatment, there is a LaMotte Unit for each constituent (Phosphate Comparator, illustrated and described below). Each unit is simple to operate and inexpensive to install. Write for illustrated booklet describing this equipment.

LaMotte Phosphate Comparator

The phosphate treatment of boiler feed water to prevent scaling has given rise to the need of a rapid, simple and accurate method of analysis, so that the proper control might be applied. This new LaMotte comparator employs two reagents, only one of which is in solution form. The range of concentration covers 0 to 100 ppm of phosphate. Higher readings made by dilution principle. Unit includes necessary pipettes, tubes, reagents in comparator with full instructions. Price $15.00 F.O.B. Towson 4, Baltimore, Md.

LaMOTTE CHEMICAL PRODUCTS CO.

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WANTED

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This well established, nation-wide organization is providing an opportunity now for several Mechanical Engineers, recently graduated, or released from the Armed Services, to train as Design, Contracting, or Sales Engineers in Power, Heating, and Industrial Piping and Equipment fields.

State in detail education, experience, salary, etc. Photograph desirable. All correspondence will be strictly confidential.

INDUSTRIAL PIPING DIVISION

GRINNELL COMPANY, INC.

PROVIDENCE 1, R. I.

Wanted: Combustion or mechanical engineer; Complete charge steam production and evaporation. Medium sized, staple food processing plant in middle west. Post war conditions will have little or no effect on business. State age, education, experience, etc. Address Box 1464, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

WANTED—In modern large meat packing plant one architectural engineer, one mechanical engineer for general designing, and one mechanical engineer to be assistant power plant engineer. Three years' minimum experience. Address Box 1467, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

ENGINEER-EDITOR. M.E. graduate. Prefer man about 40 with some practical engineering experience. Position consists of preparing booklets dealing with lubrication of various types of machinery. Permanent position. Major oil company. Location New York City. Starting salary $5,000. Give full details as to age, education and experience. Address Box 1465, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

ENGINEER — Staff Assistant on Diesel engines. Must be M.E. graduate thoroughly experienced in the engineering and operational phases. Location New York City. Salary $6,000. Replies must state complete details as to age, education and experience. Address Box 1466, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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Position Wanted—By engineer with 20 years' experience. Has broad knowledge of plant construction and maintenance, familiar with the construction and operation of reciprocating steam engines, steam turbines, diesel engines, generating units and switchboards. Have a good grasp of combustion and refrigeration. Have had particular success with power cost reduction and plant designing. Mechanical and Electrical graduated. Married. Address Box 1463, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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CRYSTOLON BRICK For Heavy Duty

High refractoriness, chemical stability and resistance to abrasion and to slag penetration make CRYSTOLON (SiC) Brick ideal for heavy duty work in stoker-fired furnaces, generators of water gas sets and combustion chambers of high temperature furnaces. The dense surface of CRYSTOLON Brick resists slag penetration so that clinkers are easily removed leaving the brick clean and undamaged.

NORTON COMPANY, Worcester 6, Mass.

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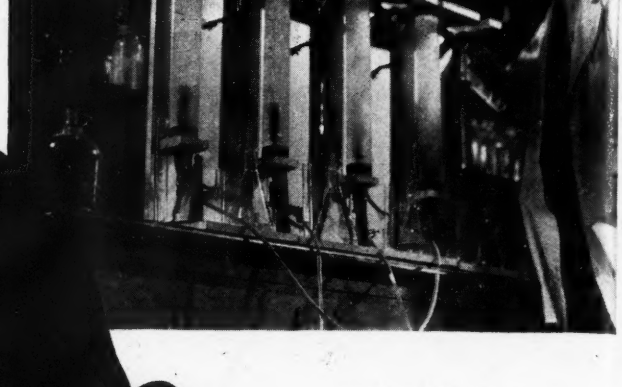
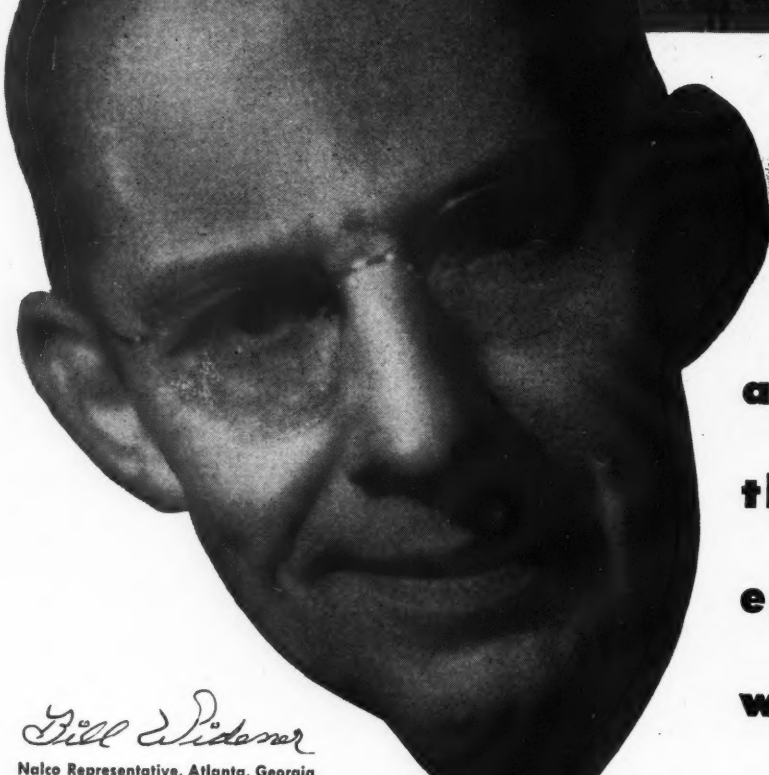


Photo in Nalco Laboratories



Bill Widener
Nalco Representative, Atlanta, Georgia

"Yes, Joe... a Nalco man thoroughly enjoys his work"*

. . . . because with the products and tools which Nalco furnishes, it is a pleasure to help you obtain the efficiency and smooth operation that the Nalco system of water treatment provides.

Looking at it from your viewpoint, Joe, this feeling and enthusiasm on the part of Nalco representatives (together with Nalco products and services) can help you prevent scale, corrosion, foaming and algae in your plant and banish a dozen other headaches that go hand in hand with untreated water. Let us show you what we mean when we say *"Nalco—the complete water treating service"* . . . . call a Nalco representative today.

* JOE . . . . *a master mechanic in a large industrial plant, an operating engineer at a utility station, a chief engineer or a power plant engineer in any industry who is eager to eliminate the troubles caused by improperly treated water.*

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6224 West 66th Place • Chicago 38, Illinois

Nalco
THE COMPLETE WATER TREATING SERVICE

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 Fuel-Oil Atomizers — Bulletin OB-PC provides capacity tables, operating hints, application ideas and other useful data on Enco fuel-oil atomizers and ignition systems for pulverized-coal burners. A valuable 36-pg reference book. The Engineer Co.

2 Improved Boiler Damper — Folder tells how the Heacon damper, with flexible curtain which unrolls at right angles to path of flow, gives better boiler regulation and increased capacity. Cartoons and diagrams illustrate design features. Thermix Engineering Co.

3 Boiler Cleaning—Bulletin No. 137 tells about the Spencer stationary vacuum cleaning system for fire tube and sectional heating boilers. Reminds us that 1/16 in. of soot reduces boiler efficiency 20 per cent. The Spencer Turbine Co.

4 Industrial Stokers—Canton Stoker Corp. Bulletin No. 202 presents data and photographs of installations of the Lo-Set Ramfeed stoker, designed for medium sized industrial boilers such as found in laundries, dairies, schools, commercial buildings, packing plants, hospitals, hotels. Bulletin No. 203 outlines advantages of the Vulcan Heavy Duty Ramfeed stoker for severe industrial applications such as power generation, process work, and central heating systems.

5 Hydroseal Ash Pumps — Catalog No. 141 gives operating details, sectional diagrams, sizes, capacities and other useful handbook data on the hydro-jet system of ash disposal. These pumps handle ashes from stoker-fired, dry bottom powdered coal-fired, and slagging furnaces. Allen-Sherman-Hoff Co.

6 Deaerating Feed Tank—Deaerating Feed Tank Instruction Manual NH-500, published by the Elliott Co., offers a 30-pg handbook plus tables and charts which, while prepared for shipboard use on navy vessels, is equally valuable to the operator of any marine equipment. It deals with the purpose of deaerating feedwater heaters, and a complete description of their construction and operation. General maintenance suggestions are also included.

ELECTRICAL

7 Protected Type Motors—Where and when to use the new Crocker-Wheeler protected type motor is covered in attractive folder. Large diagram highlights 11 unusual construction features. Crocker-Wheeler—Div., Joshua Hendy Iron Works.

8 Fiberglas Electrical Insulation — How glass in fiber form provides high tensile strength, moisture and insulation resistance and other desirable characteristics is brought out in new 24-pg Fiberglas handbook. Contains many charts and application photos on wires, tapes, mica combinations. Owens-Corning Fiberglas Corp.

9 Banding Electrical Connections — New folder describes the tools used in the Punch-Lok method of banding and splicing electrical applications; lists sizes of preformed and open end clamps available in Everdur, a copper brass alloy for electrical use; and tells how to apply the Punch-Lok bands on many electrical jobs such as connecting, splicing, reinforcing, tieing and repairing lines. B. F. Goodrch Co.

10 Lectrofilm Capacitors—General Electric Co. Bulletin No. GEA-4295 discusses radio-frequency blocking and bypass applications of Lectrofilm capacitors in communications and other electronic equipment.

11 All-Steel Industrial Fluorescents—New catalog No. 281 gives complete data on Mitchell 2-40 watt, 3-40 watt and 2-100 watt fluorescent fixtures with steel reflectors and wireway channels—open-end and closed-end types—including new perfected "instant-start" units. Mitchell Mfg. Co.

12 Unitized Switchgear—New booklets on Unitized switchgear are said to save 30 per cent of usual time required to order, build and install switchgear. Also contain many pages of factual, easy-to-use switchgear information. Westinghouse Electric & Mfg. Co.

13 Electric Heating Units—New folder tells about advantages and pictures typical applications of Trent electrically heated kettles, ovens, furnaces, space heaters, etc. Widely used in steel mills, chemical plants, laboratories, etc. Harold E. Trent Co.

FANS, PUMPS, COMPRESSORS

14 Steam Turbine Centrifugal Pumps —The use of a single set of bearings and lubricating system, the saving of space and weight and other advantages of the Coffin steam turbine centrifugal pump are covered in new bulletin. Contains performance charts, specifications and other useful data. J. S. Coffin, Jr., Co.

15 Tubejet Vacuum Pumps—Pictorial folder shows standard and special types of steam jet air ejector vacuum pumps developed by C. H. Wheeler Mfg. Co. This pump can be used with almost any type of steam condenser.

16 Air Compressors—Ingersoll-Rand Co. catalog No. 1502 discusses compressor and vacuum pumps in sizes from ½ to 10 hp. Covers Type 30 air-cooled machines with two additions, a 3-stage dual-pressure portable and two 3-stage high-pressure units.

17 Positive Blowers and Gas Pumps —Roots-Connersville Blower Corp. has issued a new Bulletin, No. G-81-D, covering its rotary positive blowers and gas pumps, centrifugal blowers and exhausters, rotary positive vacuum and liquid pumps, rotary displacement gas and liquid meters. Installation views are shown in the chemical and process industries, water works and sewage treatment plants, gas plants and oil refineries, supercharging and scavenging Diesel engines.

18 Hydraulic Handbook—60-pg Aldrich Bulletin 50 contains authoritative hydraulic information and tables, under headings: Water head equivalents, Pump plunger loads, Pressure equivalents, Capacity of shafts, Pump discharge diagrams, Friction losses in fittings and pipes, Capacities of Pumps and Cylinders, Pipe data, etc. The Aldrich Pump Co.

HEATING AND COOLING

19 New Type Cooling Towers—Binks Manufacturing Co. Bulletin No. 700 introduces an entirely new departure in small mechanical draft cooling tower design, in which the air propulsion unit consists of a slow-speed double-inlet blower, resulting in exceptionally quiet operation. Bulletin No. 600 features a complete line of horizontal, induced draft cooling towers, in which the air inlet supply is obtained through the rear, using aluminum alloy propeller type, induced draft fans.

20 Heat Transfer Equipment—Shown in new Vogt Bulletin HE-5 are standard and special built heat exchangers, atmospheric and submerged condensers, unit tank heaters. Contains many application photos; construction diagrams. Henry Vogt Machine Co.

21 Cooling Tower Handbook—Scope of design on mechanical draft water cooling towers, operating principles, forced vs. induced draft, engineering considerations—are among headings of new handbook issued by C. H. Wheeler Mfg. Co. Contains many diagrams, tables on relative humidities, etc.

22 Safety Water Heater—Described in new folder are the safety features and operating details of the Coe Safety Heater. Uses high pressure steam, requires only three connections. The Coe Manufacturing Co.

23 Evaporative Condenser with Air Filter—How the Wat-R-Miser is fitted with an air filter to eliminate dirt formations, clogged spray nozzles and excessive head pressure is explained in Bulletin 3B. Has tables of dimensions, ratings and other useful data on cooling water, transformer oils, engine lubricating oils, etc. Drayer & Hanson, Inc.

INSTRUMENTS AND CONTROLS

24 Individual-Mount Tachometers—Bulletin No. 44-1, published by Jones Motrola Co. describes four models of Jones individual-mount tachometers and the Jones multi-range portable hand tachometer. It shows both full-face and profile views of the individual tachometers, rpm ranges available, mounting dimensions, and includes prices for tachometers and appurtenances, a section on operation, and installation data.

25 Digest of Instrument Descriptions —All Leeds & Northrup's measuring instruments, telemeters, and controls, for regulating power plant processes are briefly described in one compact section of recent 28-pg "General Catalog" issue of "Modern Precision." Equipments are grouped according to their applications; are illustrated by diagrams and installation photographs.

(Continued on Page 188)

Coupon must be filled in completely to secure literature you request. Pasting coupon on penny postcard saves time and money.

JANUARY, 1945

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph numbers:

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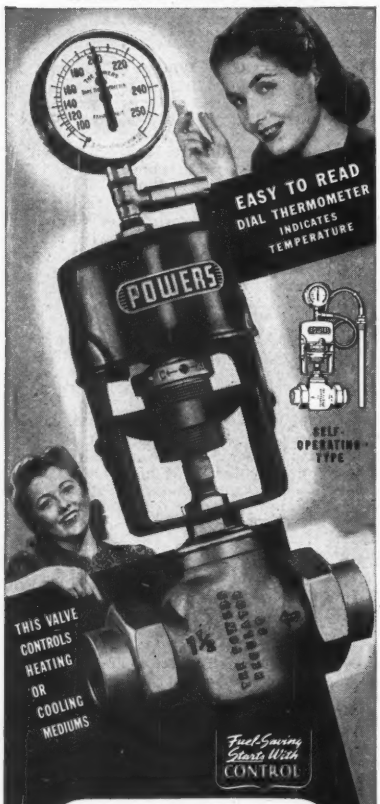
Economize WITH POWERS

TEMPERATURE REGULATORS



Use a Powers No. 11 Temperature Indicating Regulator when you want the advantages of an easy-to-read dial thermometer combined with a dependable self-operating regulator. The dial thermometer gives a visual check on the performance of the regulator and makes it easy to adjust for the required operating temperature. Various dials and ranges are available.

Is Easy To Install—because both the thermometer and the regulator operate from the same thermal system—only one tapped opening is required.

Write for Circular 2511

THE POWERS REGULATOR CO.

2746 Greenview Avenue, Chicago 14, Illinois
231 E. 46th St., New York 17, N. Y.—Offices In 47 Cities . . . See your phone directory.

70

OVER 50 YEARS
OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

26 Material-Level Indicator—Described in Bulletin I-2 is the Fuller material-level indicator to control conveyor motors, valve circuits, etc.; to give audible or visible warnings when material reaches a certain level in bin or bunker. Fuller Co.

27 Diesel Efficiency Dial—Bacharach Industrial Instrument Co. is distributing upon request a 4½ in. Diesel efficiency dial that is a trouble shooter's guide to the causes of low operating efficiency. By adjusting the dials to the cylinder pressure and exhaust temperature conditions at which the Diesel engine is operating, the guide indicates the causes for faulty operation.

28 Equipment for Power Plants—The complete line of Williams equipment for power plants is described in a new 24-pg catalog No. 449. Among items covered are Williams-Hager flanged silent check valves, Williams steam pump governors, steam operated traps, high and low alarm water columns, water gages, safety feedwater regulators. Each product is illustrated and diagrammed; tables show the entire range of sizes and complete specifications. The Williams Gauge Co.

28 Thermometers and Controls—New 48-pg Trerice Catalog No. 101-G covers construction features and applications of industrial thermometers, recording thermometers and gages, air-operated controllers and other instruments. Contains sectional views, installation diagrams. H. O. Trerice Co.

29A Tilting U-Tube Mechanical Meter—Cochrane tilting U-Tube mechanical type flow meter is described in Publication 3010-31. Three basic features are incorporated in this high torque mechanical meter: (1) Flow measurement by response to difference in pressure by a mercury seal in a U-tube. (2) Weighing mass by means of a beam balance. (3) The use of torsion tubes as the scientific solution of the stuffing box problem. Meter is said to have exceptionally high operating torque and high accuracy over long life.

MECHANICAL TRANSMISSION

30 Speed Control Data—Answers to 9 basic questions such as: what is range of speed variation—what hp capacities—is transmission of power positive at all speeds? etc. are given in new Speed Control Quiz folder issued by Reeves Pulley Co.

31 New Variable Speed Drive—Compact design, lower weight, positive drive through light V-belt, and other features of Lombard variable speed drive are covered in new folder. Drives from 1 to 100 hp and higher; ratios range from 1¼ to 1 to 70 to 1. Lombard Governor Corp.

32 V-Belt Handbook—Believed to contain the greatest amount of data ever assembled in a similar volume, The B. F. Goodrich Co. has just published a 74-pg V-Belt Handbook for Industrial Applications. It discusses the operating advantages of V-belts, qualities to seek in the product, installation and care, sheaves, selection of the V-drive, and general information.

33 Leather Belting Application Manual—New 56-pg manual offers data, charts, and specifications to support following headings—how to pick the right leather belt for the job, the figuring of belt dimensions, etc.; how to decide between modern group drive and automatic tension (pivoted motor base) drive; how to compare the efficiency and cost of multiple V-belt drives and flat leather automatic tension drives; how to figure flat leather automatic tension drives; how to install flat leather belts properly; how to make belts deliver more power and last longer. Graton & Knight Co.

34 Air-Cooled Speed Reducer—Described in Bulletin 250 is the Philadelphia air-cooled worm gear unit developed to increase ratings at worm speeds of 580 to 1750 rpm. Uses a suction fan and double walled housing to keep down oil bath temperatures. Philadelphia Gear Works.

(Continued on Page 190)

XZIT

FIRE-SCALE AND SOOT ERADICATOR

Eliminates Soot and Fire-scale without chipping or scraping

Manual chipping of fire-scale and scraping soot from boiler heating surfaces wastes valuable time and labor and ties up the unit.

Simply feed Xzit into the fire-box while your boilers continue to operate, and all accumulated fire-scale and soot will be reduced chemically so they can be dissipated by natural draft or blowing, without chipping or scraping.

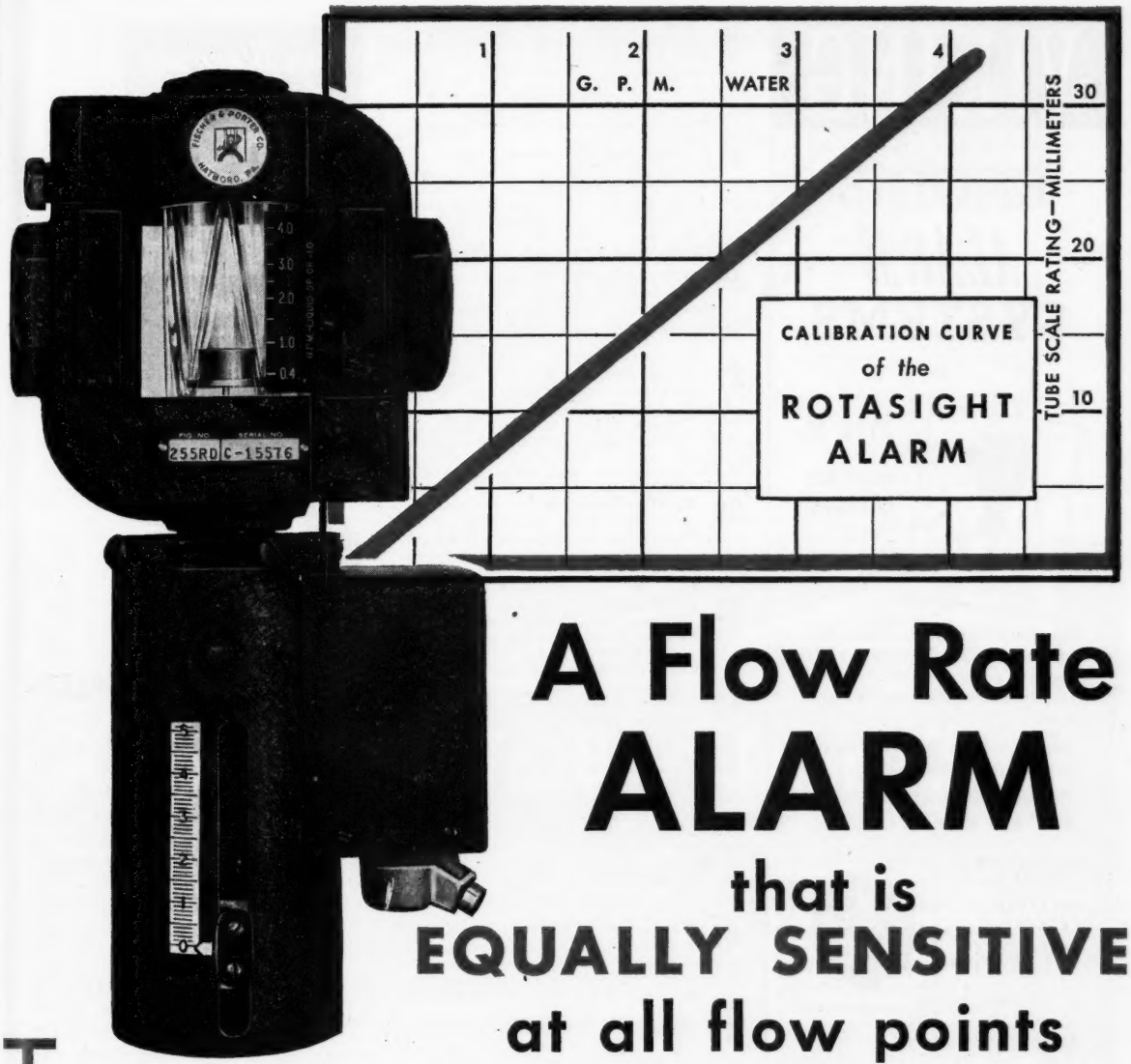
Xzit stops sparking and extinguishes stack fires instantly. Periodic use keeps heating surfaces clean, saving fuel and reducing maintenance.

Xzit is being used in all types of stationary power plants and on board American and Allied merchant and naval vessels.

Write for demonstration in your plant.

XZIT SALES CO.

1031 Clinton St., Hoboken, N. J.



A Flow Rate ALARM that is EQUALLY SENSITIVE at all flow points

THE ROTASIGHT ALARM is an excellent flow rate alarm because the float, which actuates the alarm, responds to flow rate changes only. When we add, however, that the float reacts to flow changes with the same high sensitivity at all points in the flow range, it seems to justify the statement that the Rotasight Alarm is a *remarkable* flow rate protective device. The straight-line calibration curve, shown above, is typical of the Rotasight and proves that the float moves the same distance for a given flow increment at all points in the flow range, whether high or low. The result is a Flow Alarm that is positive and accurate at the exact flow rate where you desire protection.

The Rotasight is an area-type flow meter in which the float moves up and down in a precision-bore transparent metering tube fashioned with unique V-ported flutes. All of the flow goes through the meter and the float trips an external magnetic switch at the alarm point. The external switch is adjustable easily and quickly to any point over the entire flow range of the instrument.

The Rotasight is cast in iron and bronze in sizes from ¼" to 2½" inclusive. It will handle minimum flows of 0.03 G.P.M. of liquid and 0.06 C.F.M. of gas, and maximum flows of 60 G.P.M. of liquid and 135 C.F.M. of gas. Larger flows up to 14,000 G.P.M. liquid or 16,000 C.F.M. gas may be metered in our Rotasleeve Alarm.

Leading manufacturers are using the Rotasight Alarm to protect expensive machinery and critical products. The full details are contained in an interesting new booklet 92-C, just off the press. You may obtain a free copy by writing us for it upon your Company letterhead.

The Rotasight Alarm may be equipped with explosion-proof switch housing for hazardous locations.

FISCHER & PORTER CO.

5801 County Line Road, Hatboro, Pennsylvania

VIKING

ENGINE *ALARM* SYSTEMS

TYPE M

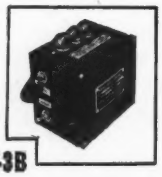
CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

COMPLETE ALARM SYSTEM



TYPE M-3B

Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT

TYPE C

CONTACT MAKERS

Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

VIKING INSTRUMENTS, INC.

403 Fairfield Ave., Stamford, Conn. Telephone 4-7375

35 New Variable-Speed Transmission —Bulletin describes new American Speed-Jack, contains complete information on this unit for drives up to 1 hp. Points out universal mounting, remote control and other exclusive features; provides specifications and installation data. The American Pulley Co.

35A Coupling Data Book — How the Waldron gear type coupling cures jitterbug shafts is explained in Catalog No. 56. Also gives rating tables, operating hints and other useful data on couplings. John Waldron Corp.

PIPING, VALVES AND FITTINGS

36 Hose and Fittings—Pictured and described in new Bowser folder are synthetic rubber hose, metal-lined fabric covered hose, air hose, water hose, quick detachable couplings, nozzles and other fittings. Bowser, Inc.

37 Spray Nozzles—Bulletin No. 2046 tells about Edco spray nozzles for oil burners, cooling circulating water for condensers, washing coal, spraying brine, other refrigeration and industrial uses. Contains capacity tables and other useful engineering data. Eddington Metal Specialty Co.

38 Flexible Metal Hose—Booklet entitled Flexible Metal Hose for Every Industrial Use has size and specification tables, construction views, application suggestions on metal hose for steam, oils and gases. Chicago Metal Hose Corp.

39 Steam Traps—Yarnall-Waring Co. Bulletin No. T-1739 covers features, construction details, applications, installations, operating suggestions, capacities, weights, dimensions and prices of Yarway steam traps.

40 Corrosion Handbook — "Corrosion", a 54-pg publication issued by The International Nickel Co. is a comprehensive analysis of corrosion principles. An opening section explains how corrosion processes work, and discusses all the known factors that influence their action: acidity of solution, oxidizing agents, temperature, agitation, films, inhibitors, surface condition, stress, heat treatment, welding, concentration cells, and galvanic action. These discussions are illustrated with graphs, drawings and tables.

41 Valves and Fittings — Stockham Pipe Fittings Co. 142-pg catalog No. 43 presents everything the engineer needs to know about valves and fittings. Prices, weights and dimensions are listed for each item.

42 Separators and Strainer—Well illustrated catalog covers advantages of various types of boiler drum and steam line separators, strainers, desuperheaters. Contains many helpful charts and dimension tables. Dri-Steam Products, Inc.

WATER TREATMENT

43 Scale Control in Water Jackets—Recent issue of HOH Lighthouse describes chrom glucosate method of preventing scale and corrosion in water jacket cooling systems of engines and compressors. Contains helpful charts. D. W. Haering & Co.

44 Purification of Hydrous Oxide Sols —Reprint of article by John W. Ryznar outlines a new method of preparing and purifying hydrous oxide sols through use of ion exchangers. Method is said to be simple, inexpensive. National Aluminate Corp.

45 Chemical Proportioning Pumps—Handsomely illustrated Catalog No. P-41 gives specifications and advantages of Hills-McCanna chemical proportioning pumps. Photos of typical installations. Hills-McCanna Co.

46 Chemicals for Water Analyses—New 44-pg booklet presents various apparatus and chemicals used for Industrial Water Analyses for plant control. Features test sets required for such determinations as hardness, alkalinity, phosphate, sulfate, dissolved oxygen, pH value, silica, and others. In addition, numerous comparators, photometers, turbidimeters and so forth are displayed. W. H. and L. D. Betz.

(*Continued on Page* 192)

Your Blueprint for

MORE POWER

starts with

OAKITE CLEANING

. . . Cleaning Clogged Lube Oil Coolers . . .

When you clean clogged lube oil coolers the more effective Oakite way, with plant-tested methods and materials that successfully expedite the work, you will find that limescale, rust, carbonized oil, or other insulating deposits are thoroughly, quickly, safely removed.

Merely permit to "soak" or circulate the recommended Oakite solution through the water side or oil side of the cooler as directed. Then rinse. Inspection will reveal that all accumulations have been completely removed and normal heat transfer efficiency fully restored. Time is saved, units are returned to service without delay, and maintenance costs reduced to a minimum.

WRITE FOR FREE MANUAL

It gives cost-cutting tips for cleaning lube oil coolers, preheaters, jacket water coolers, feedwater heaters, evaporators, transformers and other maintenance jobs.

OAKITE PRODUCTS, INC.

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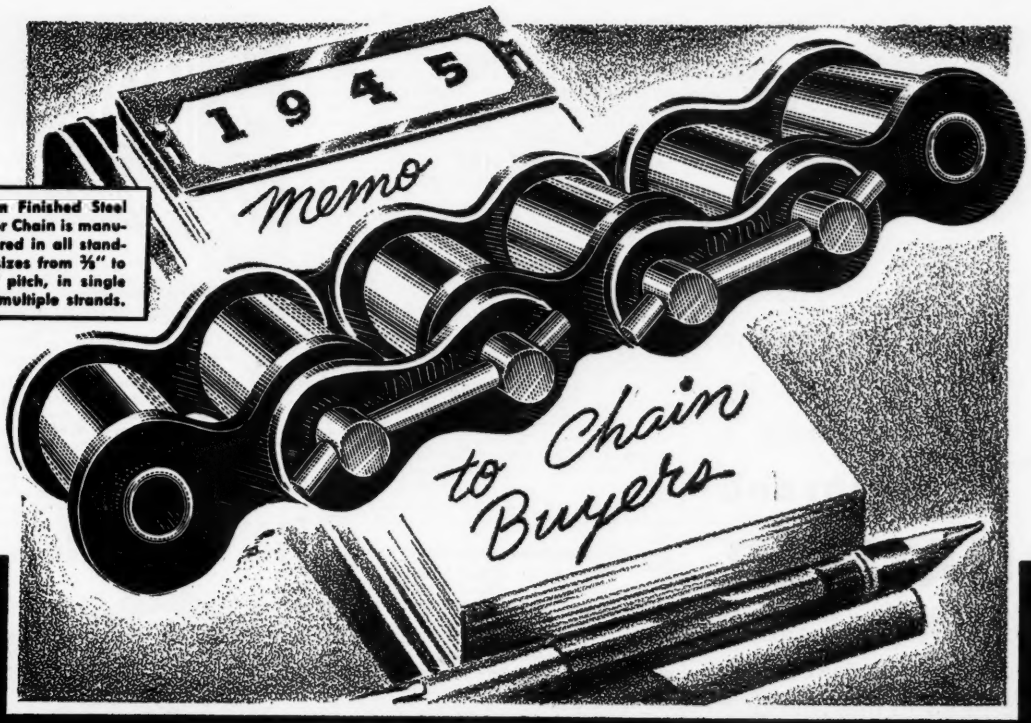
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Buy Bonds for Victory

Specialized cleaning

MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT



Union Finished Steel Roller Chain is manufactured in all standard sizes from ⅜" to 2½" pitch, in single and multiple strands.

A Good Year To Buy Union Chain

Because this year will bring peace much nearer, if not actually realized, and our thinking will turn more to the making of products for use in the postwar world. The same Union Chains now being assembled as integral parts of many war machines will be ready to perform similar operations in peacetime products and to accept assignments of power transmission and materials handling in their production. Every year is a good year to buy Union because Union Chains and the organization by which they are made have a reputation with chain buyers for "wearing well".

The Union Chain and Manufacturing Company ..... Sandusky, Ohio, U. S. A.

Union Catalog A-2 covers Drive and Conveying Chains. Catalog B-2 covers Finished Steel Roller Chain and Sprockets. Ask for your copies.

UNION CHAINS

Union Chains for Every Application

Drive and Conveying Chains and Sprockets
- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

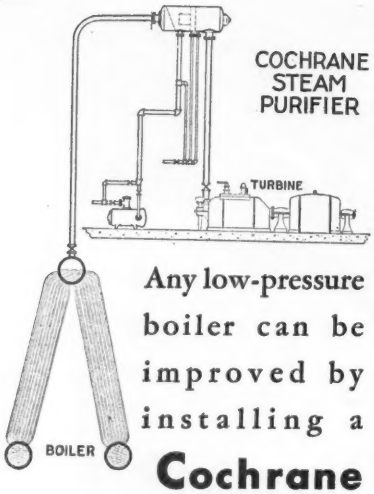
Finished Steel Roller Chains and Sprockets
- All manufacturer's standard, size ⅜ in. to 2½ in. pitch
- Single and Multiple Strands
- Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

★

Silent Chain and Sprockets
- All sizes ⅜ in. to 1½ in. pitch

★

Flexible Couplings
- Roller chain type
- Silent chain type



Any low-pressure boiler can be improved by installing a **Cochrane**

PURIFIER

How to get greater capacity from low-pressure boilers is the problem that confronts operators in many power plants all over this country. For many years the Cochrane Purifier has been one answer to this particular problem. In some instances boiler output has been practically doubled after installing Cochrane Steam Purifiers or Receiver Separators. For example:

A large industrial plant in Indiana needed more boiler capacity quickly, but 400 h.p. was the maximum load that could be carried on the 250 h.p. boiler without danger from slugs of water. After installation the owner writes: "We are now carrying 700 h.p. on the boiler whereas before installing the Cochrane Purifier we were able to carry only 400 h.p. without carry-over."

Write for a copy of Publication 2725

COCHRANE CORP., 3123 N. 17th St., Phila. 32, Pa.

47 Cathodic Method of Rust Prevention—How the Rustop electrochemical system prevents underwater corrosion in water tanks, standpipes, pressure tanks and many types of process equipment is described in new folder. May be installed without draining tank; uses ac or dc. Electro Rust-Proofing Corp.

WELDING

48 Electric Welding Connections—New 12-pg catalog describes complete line of cable connections for electric welding as manufactured by Tweco Products Co. Items include electrode holders, plain and insulated, ground clamps, cable connectors, machine terminals and cable lugs.

49 Stainless Steel Welding Data Book—A helpful book on Page-Allegheny stainless steel welding electrodes was recently issued. Besides suggestions on how to select the proper electrode for welding stainless steels, it includes hints on welding procedures and recommendations. Gives information on types of electrodes including application recommendations, physical properties and chemical composition of the weld metal, current range and sizes and packing. Page Steel and Wire Div. of American Chain & Cable Co.

50 Oxyacetylene Pipe Line Installations—New 12-pg booklet, "Oxyacetylene Pipe Line Installations" gives advantages of gas piping systems for medium and large-volume users of oxygen and acetylene in welding, cutting and other flame processes. Details on pipe sizes, central depot location, station outlets, safety devices, and other data. Air Reduction.

MISCELLANEOUS

51 Non-Slip Safety Flooring—Physical properties and advantages of Goodyear Griptred are described in attractive new 12-pg bulletin. Abrasion resistance and non-slip quality makes it suited to factory walkways and stairs, engine rooms, dairies, etc. Goodyear Tire & Rubber Co.

52 Stop and Lock Nut—How the Flexloc one-piece stop and lock nut works, how it resists backing off when seated, how it can be used over and over again, etc., are described in new folder issued by Standard Pressed Steel Co.

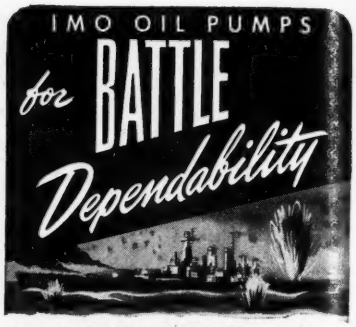
53 New Vibration Mount—Rexon, a new type of vibration mount that cannot be damaged by overload, is described in a recent folder. All an engineer need know is total weight, weight distribution of the machine to be insulated, whether direction of the vibration is vertical or horizontal. Hamilton Kent Mfg. Co.

54 Revised Duronze Manual—Bridgeport Brass Co. has published a revised edition of their 80-pg Duronze Manual, which contains specifications and technical data on five outstanding copper base engineering alloys. Outstanding is Duronze III, an aluminum bronze modified by silicon, which is 50 per cent stronger than brass, 9 per cent lighter in weight; excellent for gears, pinions, bushings, valve stems, and similar items.

55 Repairing Rutted Floors—Folder tells how Stonhard Concretite answers the problem of rough and rutted factory floors. This quick setting slab—ready in 18 to 24 hr—resists wear, water, oils, acids and above-normal temperatures; is easily applied. Stonhard Co.

56 Data on Magnesium Alloys—Described in new 16-pg handbook are forms, compositions, characteristics, specifications, etc., of Dowmetal magnesium alloys. A valuable reference for design and operating engineers. The Dow Chemical Co.

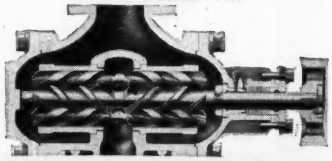
57 Mechanical Packing Handbook—New 76-pg handbook describes varied types of Chesterton mechanical packings for reciprocating rods, rotary or centrifugal rods, hot and cold water, hot oils, solvents, etc. Contains conversion tables for cutting ring packings and other useful engineering data. A. W. Chesterton Co.



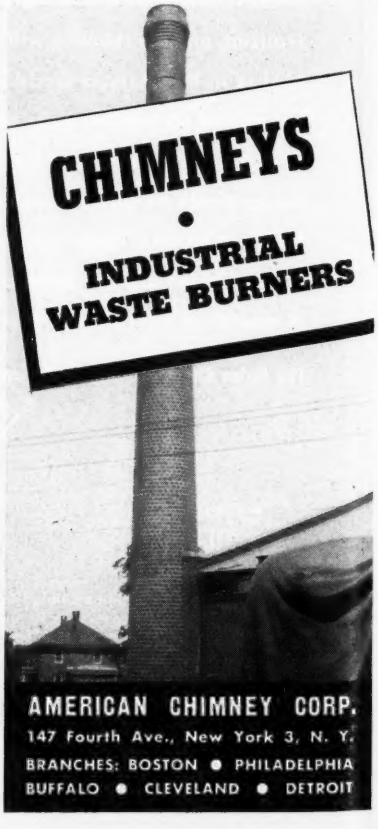
A cruiser of the U. S. Navy, one of the classes of ships equipped with De Laval-IMO oil pumps

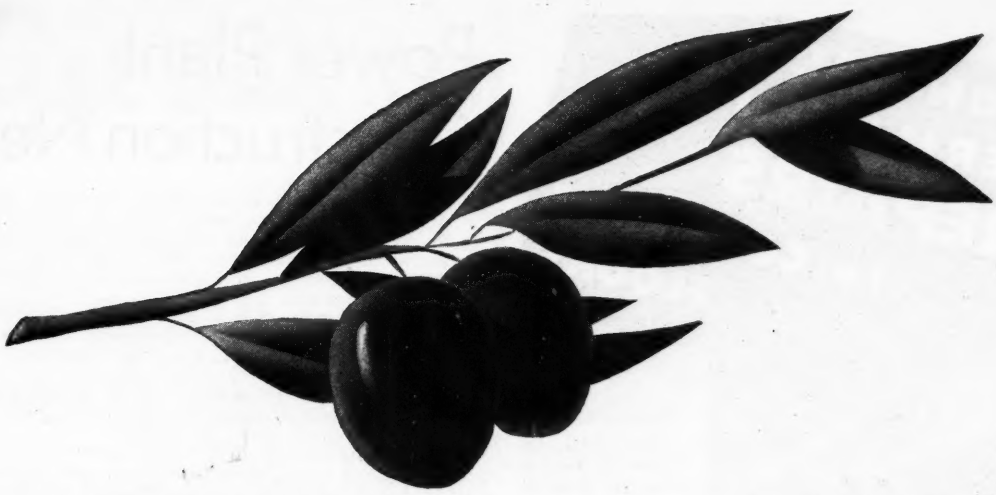
On fighting ships, where reliability and dependability under strain are all important and where space is at a premium, many thousand IMO oil pumps are in use pumping fuel oil, circulating lubricating oils, and operating hydraulic machinery. The simplicity of construction and operation that makes the IMO pump so dependable in battle assures the commercial user of long life and trouble-free operation. This unique pump has practically nothing to get out of order; it has only three moving parts, and no pilot gears or valves.

Write for Leaflet 1-117.



IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton 2, New Jersey





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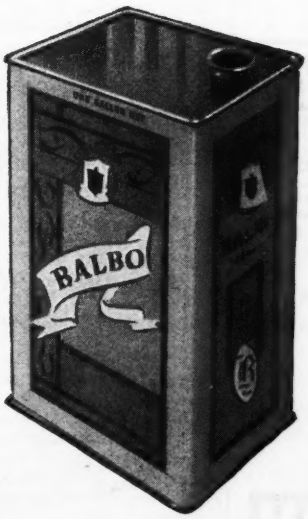
Making two olives do the work of three—or rather, making two parts of olive oil replace three—is of major importance in these times, **or any times.** And a machine that does the work of four men **and turns out five times more production** is something every business needs.

That's what the Balbo Oil Company, a leading producer of blended salad oils, accomplished with Bowser Liquid Control. Primary object was production—the Bowser way was five times faster than the old way. But Balbo also found that, with the homogenizing action of a Bowser Proportioner, 20% of olive oil gave an even better taste than 30% had previously—and **taste** is the reason for using olive oil.

But that's not all. Bowser Meters measure all incoming oil, and invoices are based accordingly . . . savings up to $24 per carload, in comparison with the former "railroad weight" basis, paid for the meters within a few weeks. Then—a Bowser Self-Cleaning Filter on the intake lines assures clear, bright oils for blending and all finished products go through other Bowser Meters en route to the packaging department—again saving time, labor, money . . . and doing a better job.

In the power industry, too, Bowser Liquid Control—turbine oil conditioners, filters and force feed lubricators, for instance—is doing a better job.

Operating tests, conducted by impartial experts, have shown that oil, if kept perfectly clean, remains as good as new. Bowser Pressure Filters, working under severe power plant operating conditions, have demonstrated their ability to keep oil clean and efficient much longer, thus prolonging the life of the equipment and saving money. BOWSER, INC., Dept. 4-A., Fort Wayne 2, Indiana.



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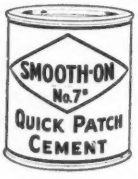

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Power Plant Construction News

Ark., Stuttgart—Arkansas Power & Light Co., Pine Bluff, Ark., has plans under way for new power substation in vicinity of Stuttgart, in conjunction with extensions in transmission and distribution lines in that area. Cost reported about $80,000, with transformers, switchgear and auxiliary equipment.

Conn., Plainville—School Board, Plainville, plans new boiler house for central heating service at high school, Main St., in connection with a postwar expansion program, including new two-story and basement addition for vocational shops and other service. Entire project is reported to cost approximately $700,000. William J. Provoost, 421 Main St., Stamford, Conn., is architect.

Ill., Carlyle—Light and Power Department, Carlyle, has tentative plans under advisement for postwar expansion in steam-electric generating station, including installation of a new 1500-kw turbine-generator, boiler and auxiliary equipment. Cost reported close to $110,000.

Ill., Chicago—Amco Mfg. Co., 2319 North Springfield Ave., manufacturer of metal products, plans installation of electric power equipment in proposed new one-story plant on Fullerton Ave., near Cicero Ave., about 60×105 ft, to cost over $50,000. Project is understood to have a priority rating and work will begin early in 1945. Sivert Klefsted, 3600 West Fullerton Ave., Chicago, is architect.

Ind., Fort Wayne—Perfection Biscuit Co., 250 Pearl St., plans installation of ovens, electric power equipment, conveying and other mechanical-handling apparatus in new one and two-story and basement baking plant. Project is understood to have a priority rating and work will begin soon. Cost estimated about $100,000. A. M. Strauss, Cal-Wayne Bldg., Fort Wayne, is architect.

Ind., Indianapolis—Indianapolis Power & Light Co., Indianapolis, has plans maturing for new one-story and basement addition to local Perry steam-electric generating station, Kentucky Ave., for expansion in steam division, reported to cost over $275,000, with equipment. Contract for high-pressure boiler has been awarded to Babcock & Wilcox Co., New York, N. Y., and orders for other required equipment will be placed soon. Gibbs & Hill, Inc., 450 Seventh Ave, New York, is consulting engineer.

Iowa, Waterloo—John Deere Tractor Co., Waterloo, manufacturer of farm tractors and other agricultural implements, plans installation of electric power equipment in new plant units to be erected on neighboring tract of 50 acres of land, recently acquired, including foundry, pattern shop, machine shops and other structures. Entire project is reported to cost close to $3,500,000. Application has been made for a priority rating and work will begin as soon as permission is secured.

Md., Hagerstown—American Fruit Growers, Inc., Professional Arts Bldg., Hagerstown, plans boiler house for central-heating service in connection with new fruit-packing, storage and distributing plant on local tract of about 10 acres of land. A cold storage and refrigerating plant also will be built. Entire project is reported to cost about $375,000. Application has been made for a priority rating. Simon & Simon, Fidelity Philadelphia Bldg., are architects; Charles H. Wolf, Otis Bldg., is engineer, both Philadelphia, Pa.

Mass., Grafton—Wyman-Gordon Co., Inc., 105 Madison St., Worcester, Mass., manufacturer of steel forgings for aircraft, etc., plans installation of electric power equipment in new plant at Grafton, where site has been acquired. It will consist of a main one-story building, 175×400 ft, and several auxiliary structures. Entire project is reported to cost over $1,000,000. J. R. Worcester & Co., 79 Milk St., Boston, Mass., are consulting engineers.

Mich., Bay City—Electric Light Department has plans under way for extensions and improvements in municipal electrical distribution system, including power substation facilities, to be carried out as a postwar project. Cost reported close to $175,000. Ayres, Lewis, Norris & May, Ann Arbor, Mich., are consulting engineers.

Mich., Coldwater—Board of Public Works, 21 South Monroe Street, has authorized plans for extensions and improvements in municipal steam-electric generating sta-

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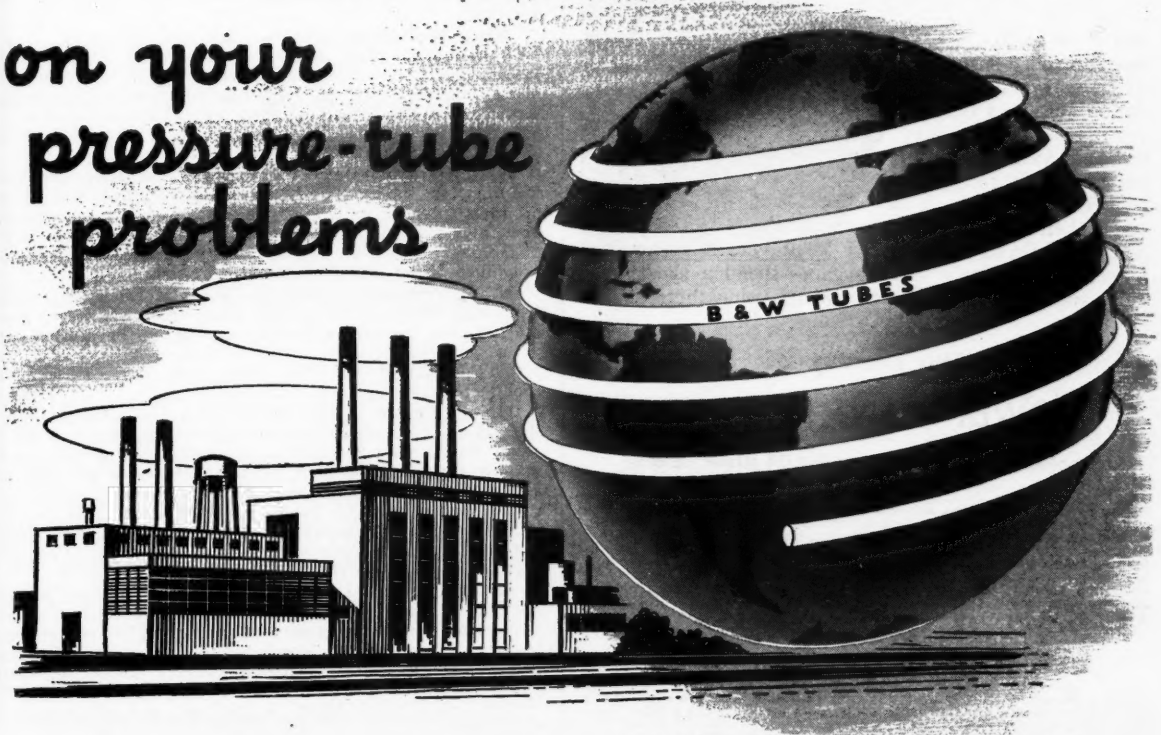

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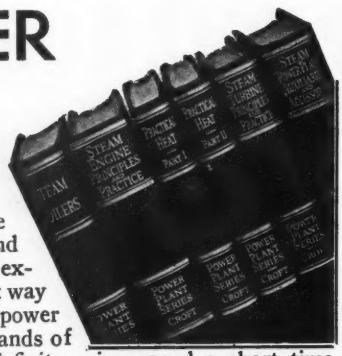

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tion, to be carried out as a postwar project. Work will include installation of a new boiler, cooling, coal storage and handling facilities, and miscellaneous equipment. Cost estimated close to $300,000. Froehlich & Emery Engineering Co., Toledo Trust Bldg., Toledo, Ohio, are consulting engineers.

Minn., Mora—Land O'Lakes Creameries, Inc., 2201 Kennedy St., N. E., Minneapolis, Minn., plans boiler house in connection with new one and three-story milk dehydrating plant at or near Mora, where site is now being selected. Entire project is reported to cost over $100,000, with equipment. A priority rating has been secured. Max O. Buetow, 1931 University Ave., St. Paul, Minn., is architect.

Miss., Heidelberg—Rogers Lacy Co., Longview, Tex., oil operator, has plans under way for new oil refining plant in Heidelberg oil field area. Project will include a power house, pumping station, steel pressure tanks for storage service, pipe lines and other facilities. Cost reported over $500,000. Project will have a priority rating. Work is expected to begin early in 1945.

N. J., Garfield—Heyden Chemical Corp., River Dr. and Monroe St., manufacturer of pharmaceutical and drug products, plans installation of electric power equipment in new three-story addition, 45×165 ft, estimated to cost close to $225,000. Project has a priority rating and work is scheduled to be placed under way at once.

N. Y., Fredonia—State Department of Education, State Education Bldg., Albany, has plans under way for new boiler house for central-heating service, to be carried out as a postwar project. Cost estimated about $250,000. Tooker & Marsh, 101 Park Ave., New York, N. Y., are architects.

Ohio, Bellevue—Spencer Kellogg & Sons, Niagara Sq., Buffalo, N. Y., manufacturers of linseed, soybean and other oil products, plans installation of electric power equipment in new soybean processing plant and elevator on tract of about 25 acres of land near Bellevue. It will comprise several large units. A power house is planned, as well as 100,000-gal capacity water reservoir. Work will be carried out soon. A priority rating has been secured. Cost reported close to $2,500,000.

Ohio, Rossford—Libbey-Owens-Ford Glass Co., Nicholas Bldg., Toledo, Ohio, plans installation of electric power equipment in connection with extensions and improvements in sheet glass plant at Rossford. A new electric furnace and accessories will be installed. Entire project will cost about $200,000. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is engineer, and will supervise construction.

Ohio, Youngstown—Republic Steel Corp., Youngstown, plans installation of new turbo-blower at local steel mill, with capacity of about 110,000 cu ft of air per min, with surface condenser, air cleaner and auxiliary equipment. It will replace present worn out equipment. Cost estimated about $475,000. A priority rating has been secured. Main offices of company are in Republic Bldg., Cleveland, Ohio.

Ore., Newport—Yaquina Bay Fish Co., Newport, plans early construction of new one-story cold storage and refrigerating plant, about 60×170 ft, estimated to cost about $75,000, with equipment. It is understood that project will have a priority rating. Ertz & Burns, Pittock Block, Portland, Ore., are architects.

Pa., Port Allegany—Pittsburgh-Corning Corp., manufacturer of foamglass and other glass specialties, plans installation of electric power equipment in new additions to plant to double present output. Cost estimated close to $750,000. Project will have a priority rating and work is scheduled to begin soon.

Va., Fredericksburg—Sylvania Industrial Corp., Fredericksburg, manufacturer of cellulose transparent paper, plans installation of electric power equipment in connection with proposed expansion in plant for large increased output. Several new buildings for processing and general manufacture will be erected. It is understood that project will be a postwar development. No official estimate of cost announced, but reported over $500,000.

Wis., Beloit—Wisconsin Power & Light Co., Madison, Wis., is having application heard by State Public Service Commission for permission to proceed with proposed addition to steam-electric generating station at Beloit, with installation of equipment for increased output. Project has been in abeyance for a number of months. Also, for permission to make extensions in transmission lines in Beloit district. Entire project will cost close to $3,000,000.

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LIKE a fine watch it requires exacting precision and tolerances to build a diesel engine as compact as the new Sterling Viking—an engine that gives you the streamlined efficiency of a gasoline engine of the same power rating—plus the economy of diesel fuel—an engine which is the result of fifteen years of research by a company whose name for nearly half a century has been synonymous with dependability and quality.

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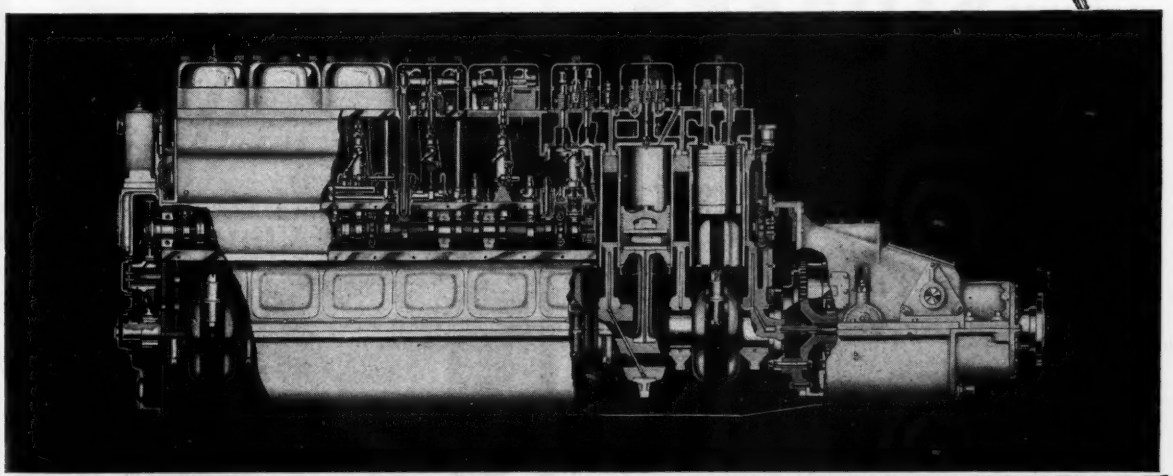

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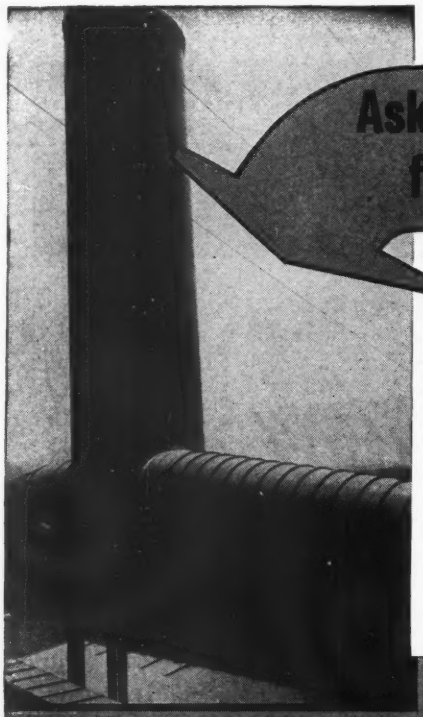

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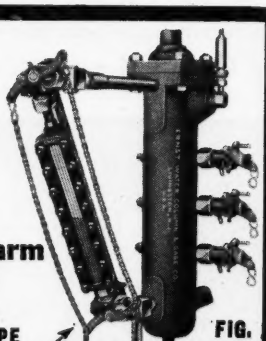
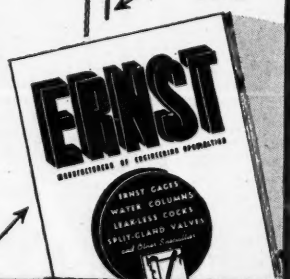


FIG. 32

OR

SPLIT GLAND TYPE

FIG. 1



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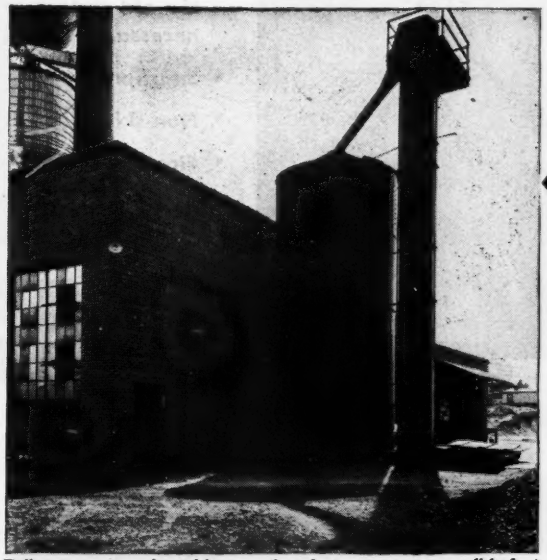
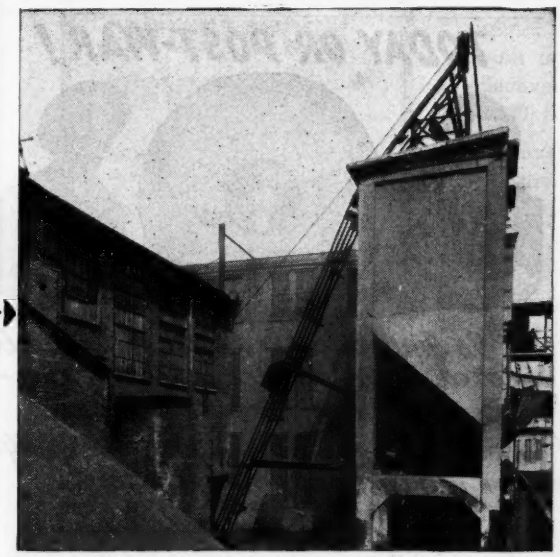
A combination Bulk-Flo elevator-feeder and horizontal screw conveyor which delivers coal from storage pile outside of boiler room, direct to boilers. This equipment replaced a time and labor-wasting practice of carting coal in wheelbarrows and firing by hand.



Boiler room expansion with covered coal storage was accomplished at this laundry without enlarging or raising roof of building or bunkers. Link-Belt elevator takes coal delivered by truck to silo with 20 ton live and 80 ton dead storage. Coal is spouted direct to boilers from this silo.



This skip hoist, solved an ashes removal problem by avoiding difficulties such as rapid wear and excessive costs experienced with two previous installations. Ashes are discharged from a dump car at basement floor level, directly to the skip bucket which is automatically hoisted, dumped, and returned by push button control.

Mechanical handling of coal from concrete bin at one side of boiler room to stoker hoppers through this inclined Rotor Lift (screw) conveyor and horizontal distributing screw conveyor, completely eliminated a coal dust nuisance at an Indianapolis hospital. Both conveyors are operated from a 5 H.P. motor.

Whether your plant is large or small, and no matter what your conditions might be, there is suitable Link-Belt equipment to meet every requirement. Before you do anything else about it, talk over your problem with an experienced Link-Belt engineer. Send for book No. 1510, "Solving the Problem of Coal and Ashes Handling."

9644

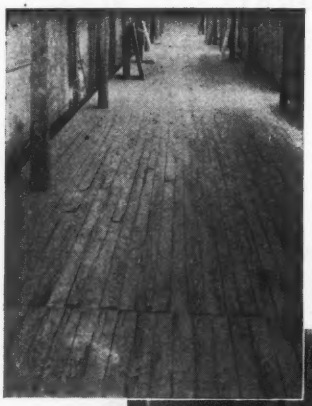
LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8. Offices in principal cities.

ONLY 1/2" DOES IT

ONLY a 1/2" topping of

STONHARD RESURFACER

is needed to resurface your worn, splintered and cracked wood floors, platforms and ramps to give you a safe, smooth floor.



- *No ripping-up of the old surface is necessary*
- *Sparkproof*
- *Non-skid*
- *Fire-resistant*
- *Easy to keep clean*

STONHARD RESURFACER

applied over concrete will eliminate ruts and holes in floors, driveways and trucking aisles. Provides a hard, smooth surface that will withstand the heaviest trucking and traffic.

- *No chipping or air-hammering . . .*
- *No involved preparation . . .*

Your Own Workmen Can Do the Job

ORDER A DRUM NOW ON OUR TRIAL BASIS AND SEE FOR YOURSELF

30 MAINTENANCE PRODUCTS

STONHARD COMPANY

Now in its 23rd Year

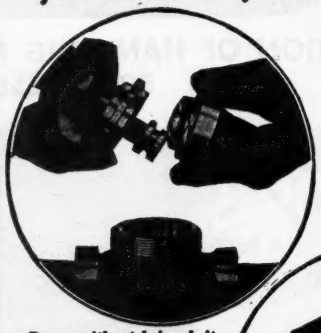
811 Terminal Commerce Bldg.

Philadelphia 8, Pa.

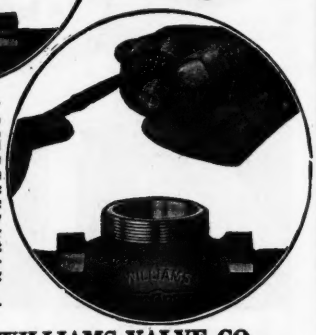
Sales Offices and Stocks in Principal Cities

Use VULCODISC

for trouble-free valve jobs



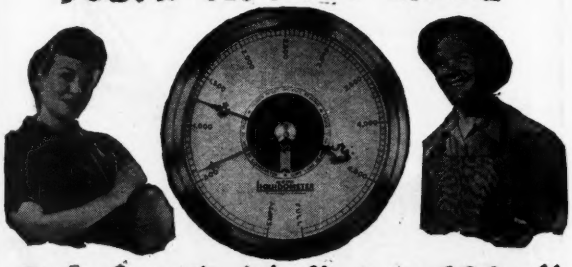
In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.



Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder. Write for descriptive bulletin.

THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

TODAY OR POST-WAR!



It Is Important to Measure Valuable Stored Liquids Accurately With—

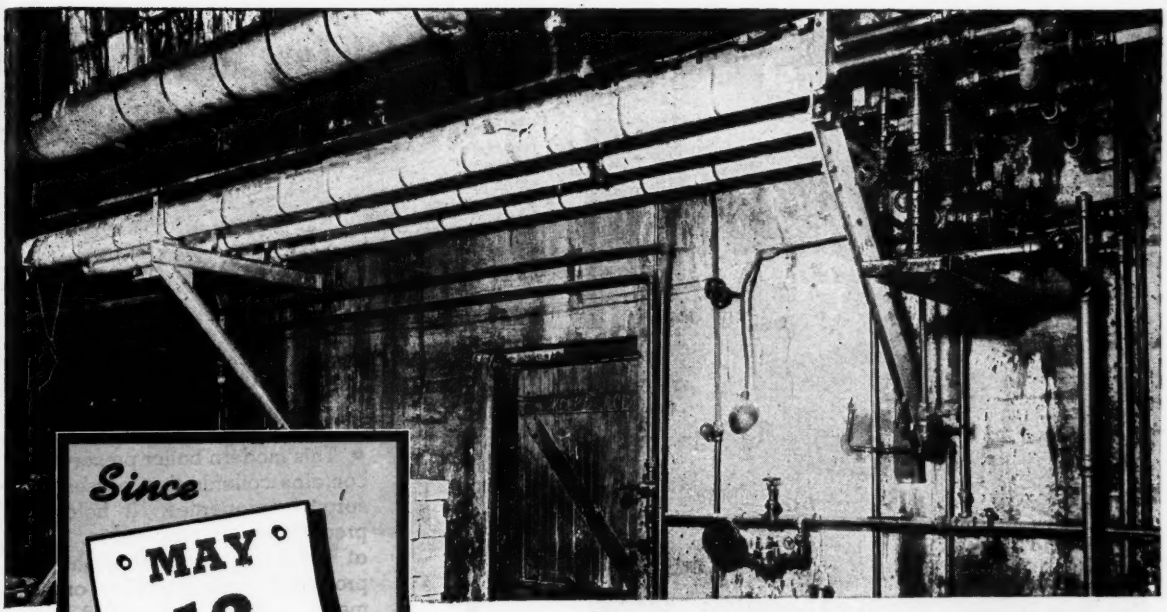
LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.
No pumps, valves, or auxiliary units needed to read them.
Models available for either remote or direct readings.
Accuracy unaffected by specific gravity of tank liquid.
Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

THE LIQUIDOMETER CORP.
36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.



Since

MAY 12 1933

Another Instance

12 YEARS OF SATISFACTORY SERVICE

The three Twin G-Fin Sections illustrated above were installed as fuel oil heaters in an industrial plant in May 1933, and are still operating with complete satisfaction. Some of the special advantages of Twin G-Fin Sections are their superior effectiveness in transfer of heat to or from fluids of high viscosity or low heat conductivity, their interchangeability which promotes flexible capacity, and their compactness and lightness which assists ease of handling and erection.

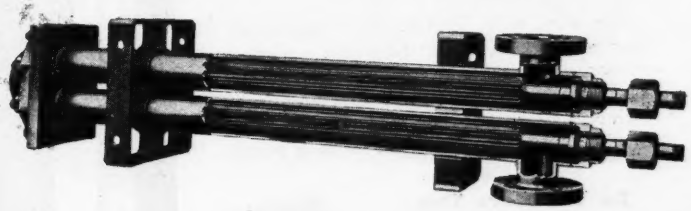
FUEL OIL HEATER SERVICE RECORDS

prove the excellence of G-FIN construction

G-Fin . . . the extended heat transfer surface with longitudinal fins originated by Griscom-Russell more than 12 years ago . . . has PROVEN its durability, as well as its effectiveness, through the operating records of more than 40,000 installed units in which G-Fin elements are used.

Moreover, the excellence of G-Fin design and construction is further proven by an unequalled range of successful applications, for G-Fin units are being used on a greater variety of services than any other heat transfer apparatus on the market.

Be sure to investigate a G-Fin Unit for your next heating, cooling, condensing or heat transfer requirement.



THE GRISCOM-RUSSELL CO.
285 Madison Avenue
New York 17, N. Y.

GRISCOM-RUSSELL
TWIN G-FIN SECTION
The Universal Heat Exchanger

The First Hills - McCanna *Proportioning Pumps* were for Water Treatment!

"U" type motor driven single unit, 2 feed.

"The first Proportioning Pumps, developed over three decades ago, were small units mainly applicable to the feeding of coagulants and treating agents into boiler water."
—From the Hills-McCanna Pump Catalog.

WHEN you require a proportioning pump for introducing *accurate* dosages of water treatment chemicals, submit your problem to "Proportioning Pump Headquarters" where you will find a size and type to *exactly* meet your needs and the engineering experience to help you get the best results from your installation.

Hills-McCanna Water Treatment Pumps are accurate, dependable and easily adjustable to pump any predetermined volumes. They can be installed to inject into the pressure side of the boiler.

Engineers, note: Stuffing box is generously large in depth and fitted to permit a number of adjustments before requiring repacking. This appreciably reduces the frequency of maintenance — another reason why Hills-McCanna Pumps are favorites in many plants.

Do You Have This Catalog?

28-page Catalog P-44 describes the complete line of Hills-McCanna Chemical Proportioning Pumps. Helpful in pump selection . . . write for a copy.

HILLS-McCANNA COMPANY
2439 W. Nelson Street **Chicago 18, Illinois**

Air and Water Valves . . . Chemical Valves . . . Marine Valves . . . Proportioning Pumps . . . Force Feed Lubricators . . . Magnesium Castings

Protect Your Boilers Against Pitting, Corrosion and Scale with

Magic BOILER PRESERVATIVE

• This modern boiler preservative contains colloids that possess adsorptive properties. It holds all precipitates in suspension, while at the same time establishing a protective colloidal film on the metal to arrest pitting and corrosion. Its action is simple, safe, sure; helps your boiler produce more steam.

Write for Descriptive Bulletin

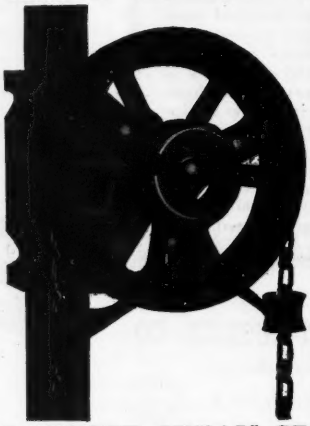
GARRATT-CALLAHAN CO.
Established 1904

OF ILLINOIS
59 East Van Buren St.
Chicago 5

OF NEW YORK, Inc.
1328 Broadway
New York City 1

OF CALIFORNIA
148-156 Spear St.
San Francisco 5

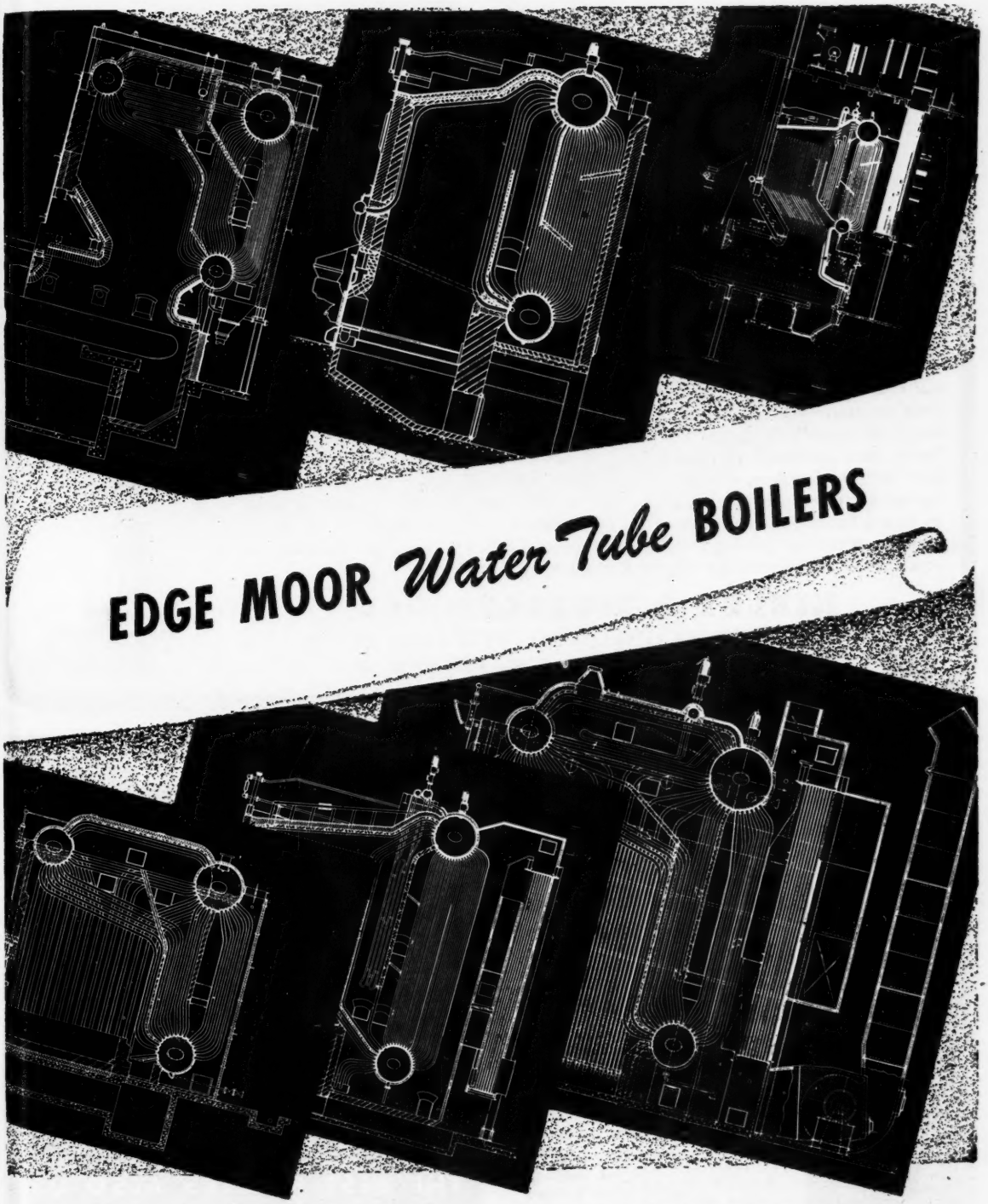
Do Away with Dangerous LADDER WORK



Stop climbing ladders to open and close those "high-up" valves. Equip them with Babbitt Sprocket Rims and you can control them quickly and safely from the floor. Babbitt Rims are easily attached and low in cost. They show real savings in time and steam—help guard against accidents. Now is the time to fit your overhead valves with Babbitt Rims. Write today for further information.

BABBITT STEAM SPECIALTY CO.
South Water, Spring and First Sts.,
New Bedford, Mass., U. S. A.

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide



EDGE MOOR *Water Tube* BOILERS

All designs of steam generators for any required capacity and up to 900 lbs. drum pressure are completely engineered and built at Edge Moor.

The combination of Edge Moor engineering and manufacturing control insures the ultimate in modern power plant construction.

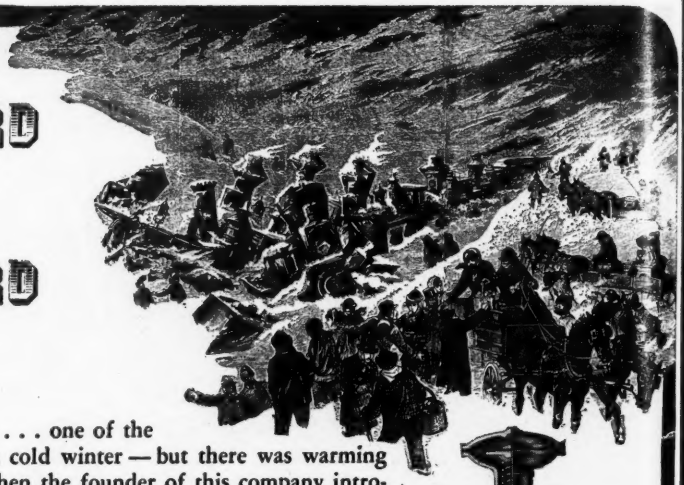
STEAM GENERATING EQUIPMENT

EDGE MOOR
IRON WORKS, INC.

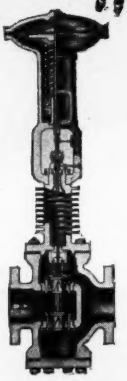
BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE: EDGE MOOR, DELAWARE

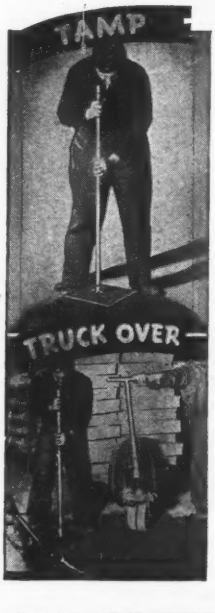
THE BIG BLIZZARD before THE BIG BLIZZARD



It began the day after New Years, 1879 . . . one of the worst storms in American history. It was a cold winter — but there was warming news for steam plant operators that year when the founder of this company introduced the world's first steam trap. For 66 years since then, Tim Kieley and his family have continued to pioneer and perfect steam specialties and pressure and flow controls. Speaking of cold winters, here's a K & M Diaphragm Motor Valve for any extremes of temperature, very low or very high. This precision device, with its finned bonnet, gives control of steam, liquids, gases or air within 1% of initial pressure. Write for Catalog No. 66, which gives full descriptions, specifications and capacities of this dependable Kieley & Mueller No. 488 Valve.



KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879
2009—43rd St., North Bergen, N. J.



How to PATCH FLOORS

. . . Without Stalling Traffic

Now you can restore broken concrete to solid smoothness without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment. *Request Descriptive Folder* and Details of FREE TRIAL OFFER.

INSTANT-USE

FLEXROCK COMPANY
3623 Filbert St., Philadelphia 4, Pa.

Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.
Name .....
Company .....
Address .....

EVERY BOILER SHOULD HAVE ITS OWN . . . . CAT'S-EYES

FOR BETTER COMBUSTION

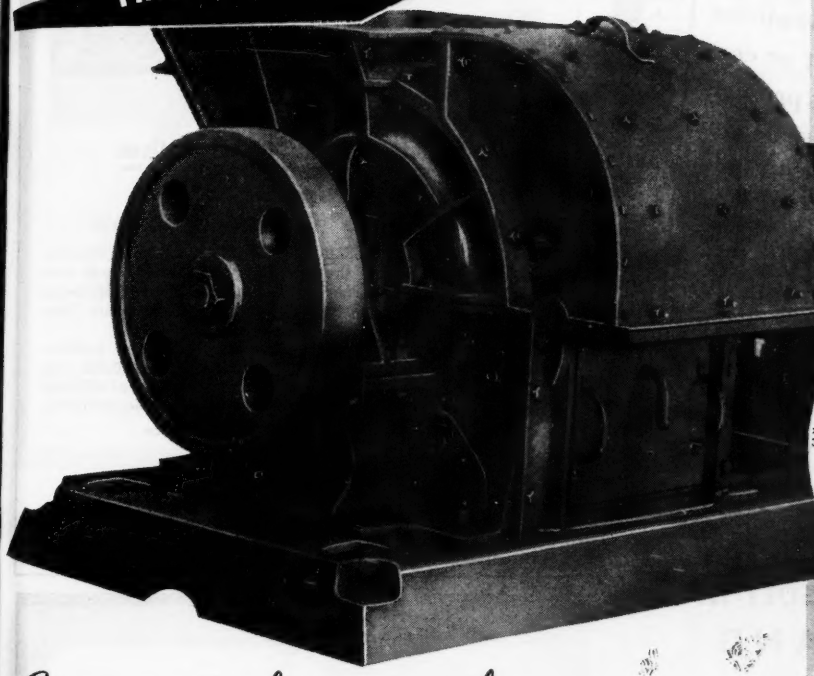
THE BEST BOILERS ALSO USE

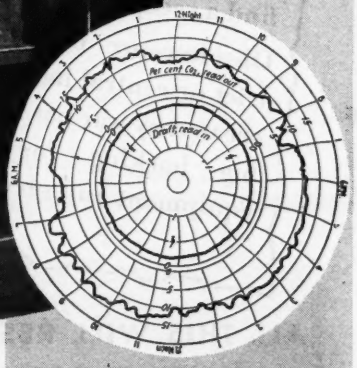
ESS HAZEGAGES or WYD-ANGLE PERISCOPES

ESS INSTRUMENT CO., FORT LEE, N. J.

Indicators, Controllers, and Recorders for Smoke Haze and Combustion . . . Specific Gravity . . . Turbidity Flame Failure . . . Industrial and Safety Applications

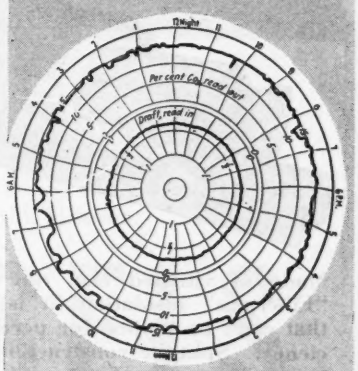
PROPERLY SIZED COAL... A "MUST" FOR THRIFTY BOILER OPERATION





CO_2 Records Show Need of Coal Sizing

The sizing of coal and its relation to ashpit losses is illustrated by the two CO_2 Charts herewith. Above shows what happens with poorly prepared coal. Below shows uniform CO_2 achieved through the installation of a coal crusher for better sizing.



Get more steam from your coal...

THE *American Crusher* WAY

IN line with the nation's program to conserve vital fuel supply, it's both patriotic and sensible to prepare coal for better sizing. This preparation results in a higher and more constant CO_2 reading—reduces the carbon content of the ash—makes your coal dollars produce more steam.

The experience of Bemis Bros. Bag Co., John Morrell & Co., Central Illinois Light Co. and scores of other plants is that AMERICAN Crushers — used in either stoker or pulverized coal burning—provide the proper coal preparation needed today for thrifty boiler operation. Many reports show that AMERICANS crush the coal exactly as required for top combustion efficiency, and at the extremely low crushing cost of *less than one cent a ton for all charges.*

The AMERICAN Rolling Ring Crusher, Type S, pictured above, has set new standards for efficient fuel sizing and trouble-free crusher operation through the use of heavy steel ribbed housing, anti-friction bearings, adjustable grinding plate, reversible manganese steel shredder rings which *split* coal instead of crushing it.

Ask our engineer to study your particular boiler plant operating conditions and offer suggestions for better sizing, lower steam costs. Write for descriptive bulletin on AMERICAN Crushers.

AMERICAN PULVERIZER COMPANY, 1429 Macklind Ave., St. Louis, Mo.

The "S" Type Is the Improved All-Steel AMERICAN RING CRUSHER

District or Central Heating Faces Bright Future

During the war, hundreds of thousands of people have been introduced to the convenience and comfort of district or central heating in housing projects and army or navy bases from coast to coast. As a result, new district heating projects will find a receptive public.

Obsolescence of existing district or central heating systems created by war has resulted in a big backlog for materials, equipment and service.

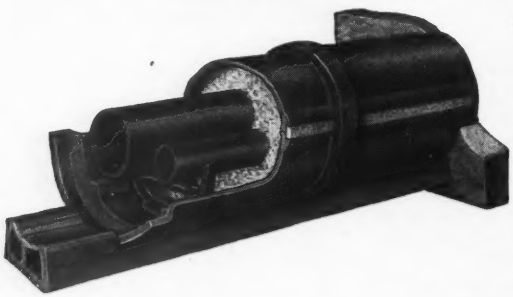
ALL THIS WILL RESULT IN A

BIG DEMAND

for

ADSCO-BANNON

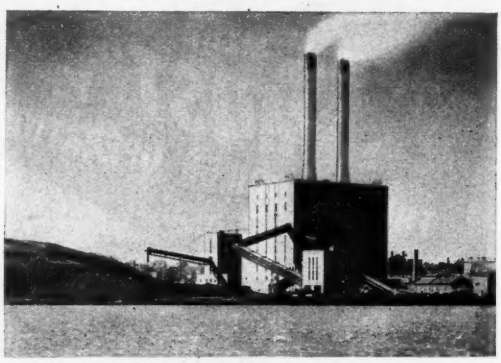
TILE CONDUIT



Made of vitrified clay tile, insulated with "Fiberglas" insulation, it is a combination that can't be topped for permanency or efficiency. Split-tile construction makes it easy to install a group of pipes. Can be furnished for several combinations of pipe in the same conduit thereby reducing cost. Write for Bulletin Number 35-67E.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years



One of America's Latest Stations

Coal Preparation by "Pennsylvania" Bradford-Hammermill

"Pennsylvania" STEELBUILT Coal Preparation Machinery, developed during the past 40 years, in six types and over 150 sizes, has been specialized for the requirements of Central Stations, Industrial Power Plants, By-Product Coke Plants, Mines and Coal Cleaning Plants.

Experience with a steadily increasing number of installations, with capacities now totaling well over 200,000,000 tons per annum, is the basis for our recommendations of efficient Coal Preparation Equipment, specialized for your requirements.

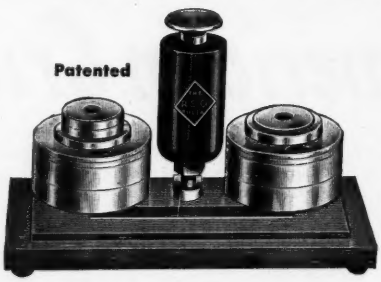
Our Engineers are at your service

PENNSYLVANIA CRUSHER COMPANY

1706 Liberty Trust Bldg., Philadelphia 7, Pennsylvania
New York, Pittsburgh, Chicago, Los Angeles, Birmingham
Associated with Fraser & Chalmers Engineering Works, London

Dead Weight Gauge

Patented



This device will measure any gas pressure to a higher degree of accuracy. It does not have to be handled gently. It never has to be checked or calibrated. Weights are brass, stacked on posts on same base as the tester. Available in Standard and High Pressure models. Delivered complete with weights and hardwood carrying case.

Can be put on a line at any connection where an ordinary gauge is placed.

LABORATORY APPARATUS
SCIENTIFIC INSTRUMENTS
POWER PLANT EQUIPMENT

THE REFINERY SUPPLY CO.

Main Office and Plant
621 E. 4th St. • TULSA 3, OKLA. • Ph. 4-8144, L.D. 581

Branch Office:
1309 Capitol Ave. Houston 2, Texas Ph. Fairfax 5514

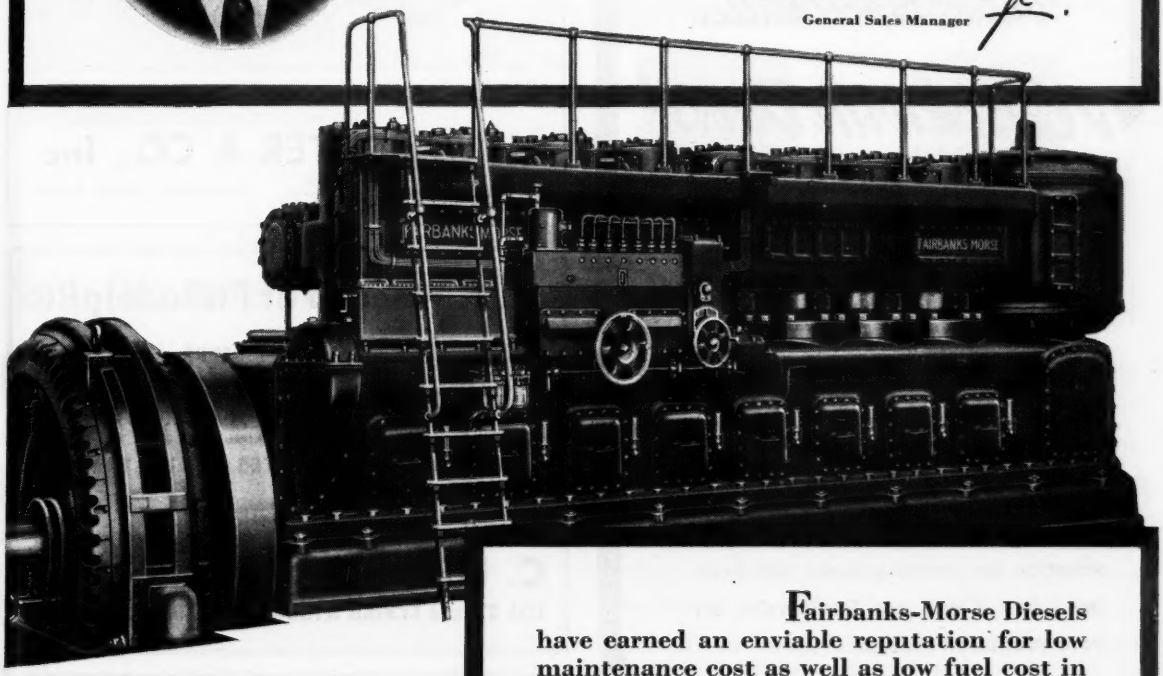
"A name worth remembering"

FAIRBANKS-MORSE

Fairbanks-Morse postwar products will serve you with the *dependability* the world has come to associate with our name. Designing and manufacturing skills will not have to be re-learned in our plants as we turn to civilian production, because as a part of our war job, we've continued to build and improve our peacetime Diesel engines, generators, motors, pumps, and scales.

R. H. Morse Jr.

General Sales Manager

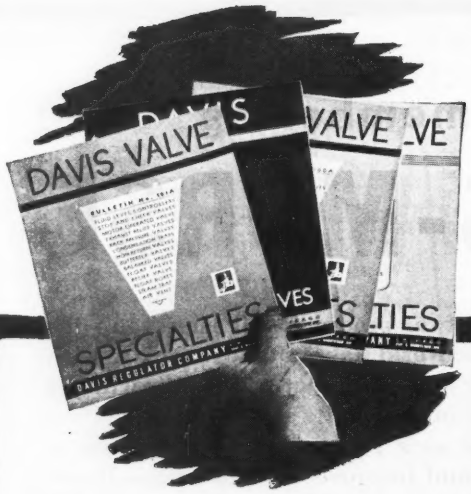


Fairbanks-Morse Diesels have earned an enviable reputation for low maintenance cost as well as low fuel cost in sustained, heavy-duty service. Fairbanks, Morse & Co., Chicago 5, Illinois.

DIESELS

Diesel Locomotives • Diesel Engines • Generators
Motors • Pumps • Scales • Magnetos • Stokers
Railroad Motor Cars and Standpipes • Farm Equipment

BUY AND KEEP
MORE WAR BONDS



HERE'S THE EASIEST WAY TO SELECT AUTOMATIC *Valve Specialities*

Check with Davis!

Davis offers one of the broadest lines of automatic valve specialties in existence today. Because selection of the right valve for the job can be a difficult procedure without proper data available, Davis offers a complete line of catalogs to acquaint you with sizes, material specifications, pressure ranges, physical data, and other pertinent information which will help you in valve selection for power, process, and heating jobs. There is a Davis valve for your particular problem.

Fill out and mail the coupon now.

Davis Regulator Co.
2508 S. Washtenaw Ave., Chicago

Without obligating me, please MAIL literature describing:

- ☐ Pressure Regulators and Pump Governors (including service and capacity charts).
- ☐ Pressure Relief, Back Pressure and Exhaust Relief Valves.
- ☐ Liquid Level Controllers for closed tanks.
- ☐ Lever and Float Operated Valves.
- ☐ Solenoid Valves for Industrial service.
- ☐ Stop and Check, Non-Return and Balanced Check Valves.
- ☐ Strainers.
- ☐ A specific problem is outlined on the attached sheet. We would appreciate your recommendations.

Name .....

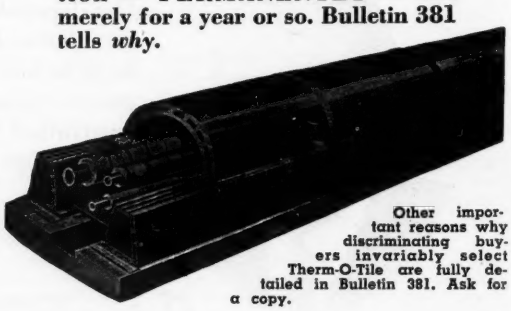
Company .....

Address .....

?? DRY INSULATION ??

That's a very important question.

Unless the insulation in underground steam conduits is really DRY, it is about as good as no insulation at all. Therm-O-Tile assures DRY insulation — PERMANENTLY — *not* merely for a year or so. Bulletin 381 tells *why*.



Other important reasons why discriminating buyers invariably select Therm-O-Tile are fully detailed in Bulletin 381. Ask for a copy.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See Sweet's Architectural File, or, The Heating Guide.

H. W. PORTER & CO., Inc.

829-E Frelinghuysen Ave., Newark 5, New Jersey

C. H. Wheeler of Philadelphia

STEAM CONDENSERS

•

STEAM EJECTOR TYPE VACUUM PUMPS

•

MECHANICAL DRAFT WATER COOLING TOWERS

•

DECK MACHINERY

C. H. WHEELER MFG. CO.

19th ST. and LEHIGH AVENUE, PHILADELPHIA 32, PA.

FOR SALE

New and Reconditioned Iron and Steel

VALVES

ALL TYPES AND SIZES
ALSO FITTINGS

Tested and Guaranteed

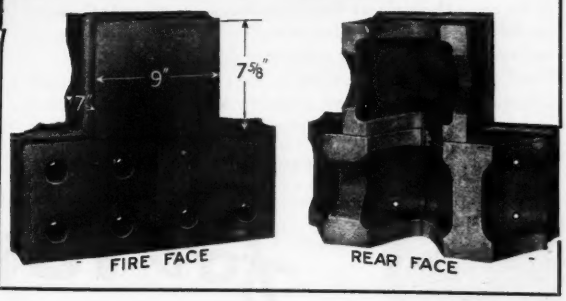
APEX IRON & METAL CO.

2204 S. Laflin St. Chicago 8, Ill.

HAVE YOU A CLINKER ADHESION PROBLEM?

ABOVE: Front furnace wall, built with Bernitz Super Blocks, after 26 months' operation

AT RIGHT: How Bernitz "S-100" Blocks are laid "T & U." Differing from all "T" construction, the bond is broken by the blocks themselves



How the sum of many little problems becomes a BIG one

Clinker adhesion on furnace walls is a major problem these days because it shortens the life of the setting; causes outage for cleaning and repair; requires more time and labor during cleaning periods; cuts the capacity of the unit, and raises the cost of generating steam.

Moreover, the coals generally are of poorer quality than in pre-war days, and there is little hope for improvement in the near future.

Some plants also have trouble keeping crews to do the heavy labor necessary to keep their furnaces in workable condition between regular shutdown periods.

Bernitz SUPER BLOCKS are helping lick these problems in many hundreds of plants today. They are made of "Carbofrax," the Silicon Carbide refractory which inherently resists clinker adhesion. Their high thermal conductivity and correct design permit effective cooling, promoting a long life of usefulness.

Absence of clinker formation on walls built with Bernitz Blocks reduces cleaning time to a minimum. All of the grate surface is available for burning fuel all of the time, and full capacity of the unit can be maintained during the entire operating period.

BERNITZ
FURNACE LININGS

BERNITZ FURNACE APPLIANCE CO., 89 BROAD ST., BOSTON 10, MASS.

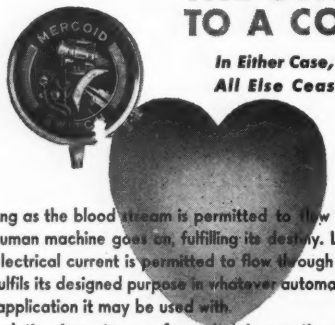
New York Philadelphia Detroit Buffalo Syracuse Atlanta Pittsburgh
Cincinnati Chicago Indianapolis Minneapolis St. Louis Cleveland
In Canada: Williams & Wilson, Ltd., Montreal and Toronto

BERNITZ CO. PRODUCTS *include:*

Bernitz Super Blocks, Air Cooled
Bernitz Nygaard Water Wall Blocks for Walls & Arches
Bernitz Air-Cooled Floors
Bernitz Super Generator Linings for Water Gas Sets

WHAT THE HEART IS TO LIFE THE SWITCH IS TO A CONTROL

In Either Case, When One Fails All Else Ceases To Function



As long as the blood stream is permitted to flow through the heart, the human machine goes on, fulfilling its destiny. Likewise, as long as the electrical current is permitted to flow through the switch the control fulfils its designed purpose in whatever automatic heating or industrial application it may be used with.

The relative importance of a switch is sometimes overlooked, especially in an automatic control. In the event of a switch failure, as in the case of a boiler pressure or temperature limit control, as well as other important applications, the failure may prove hazardous and costly. That is why from the very beginning, Mercoid Automatic Controls were equipped exclusively with the now famous hermetically sealed Mercoid mercury switches, known and used the world over. They provide an electrical contact designed for millions of perfect operations —one reason why Mercoid Controls are noted for their long life and better performance. Mercoid switches are immune to dust, dirt, moisture or corrosion. They are not subject to open arcing, pitting or sticking of the contacting surfaces. That is the reason why Mercoid Controls are following the Army in some of the far outposts where adverse and extreme humid weather conditions exist.

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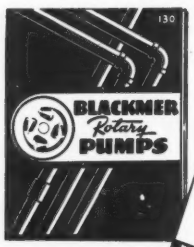

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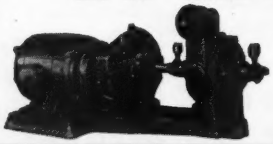

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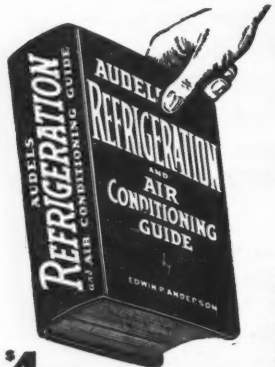

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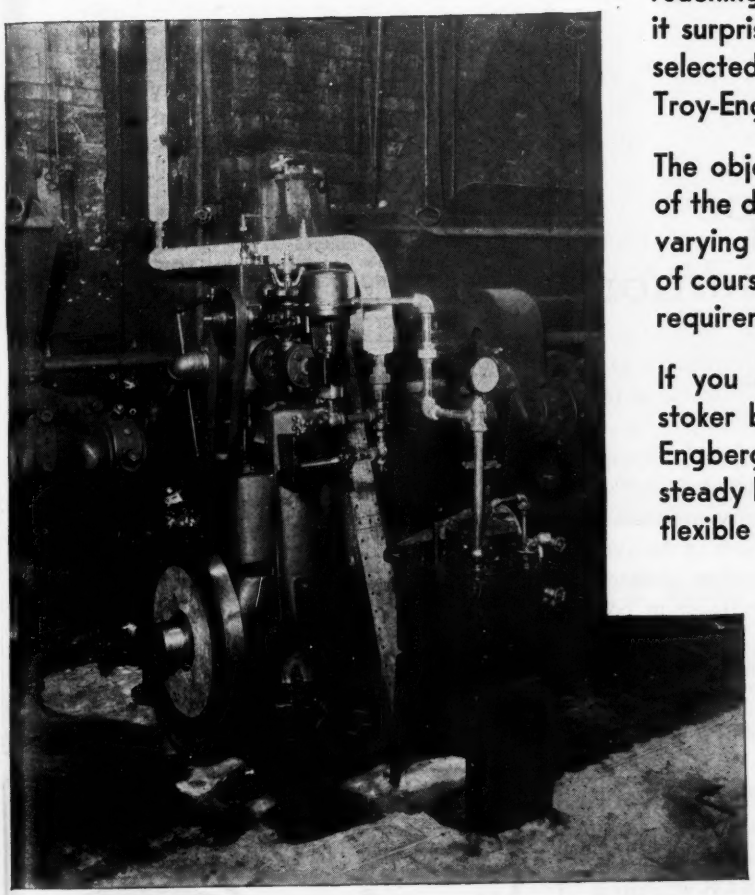

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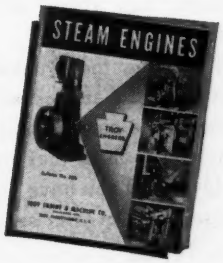

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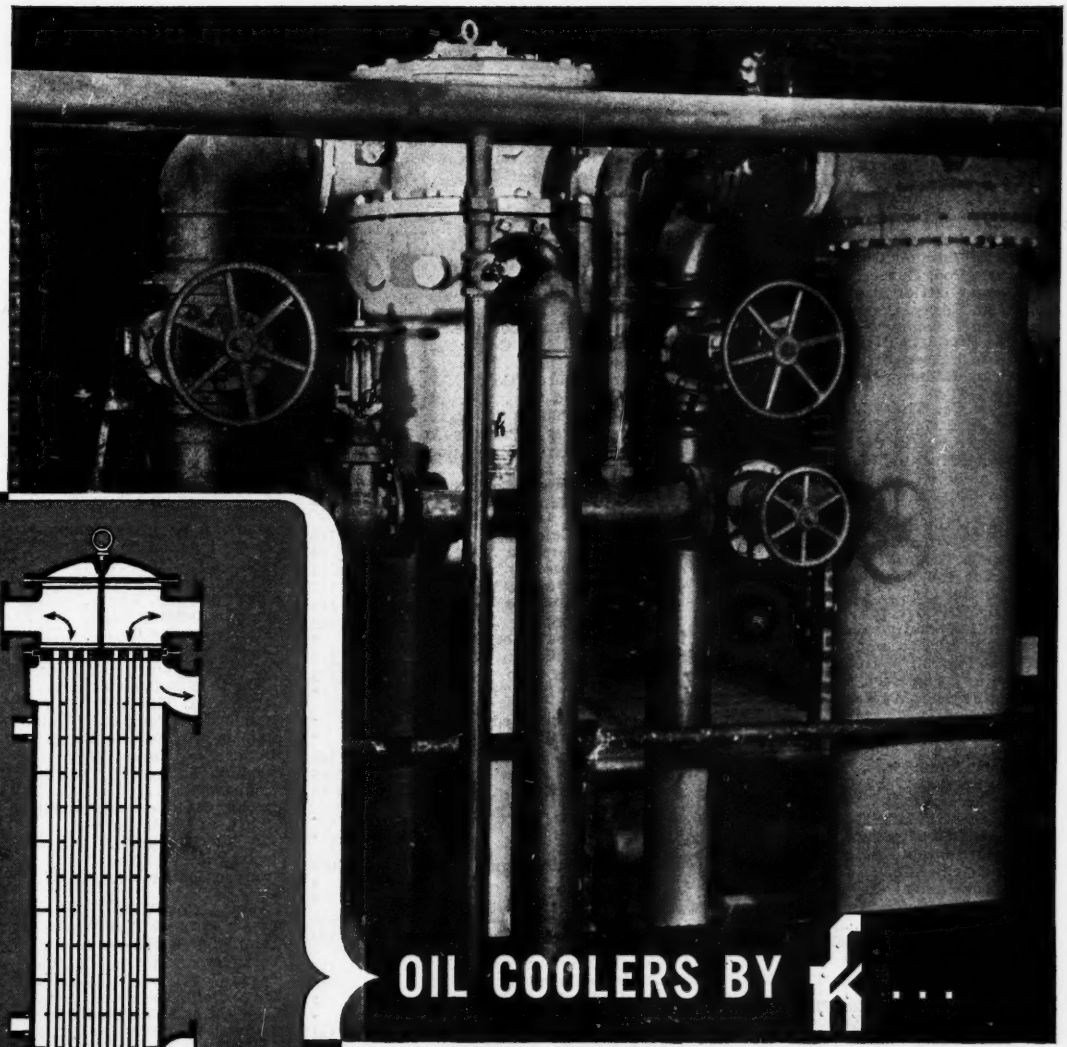

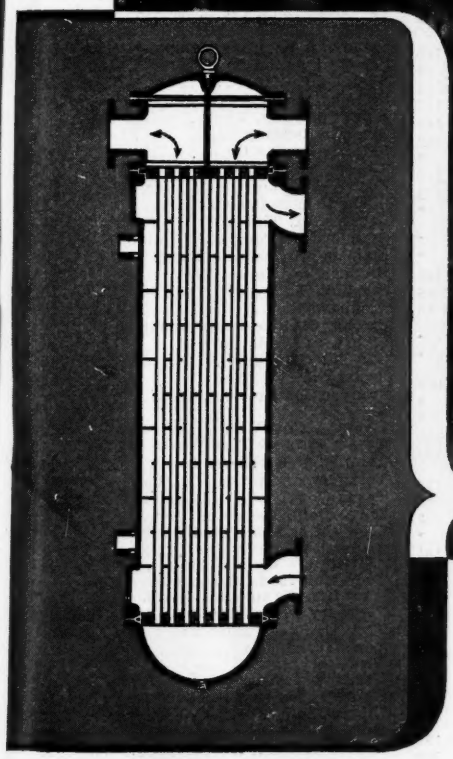

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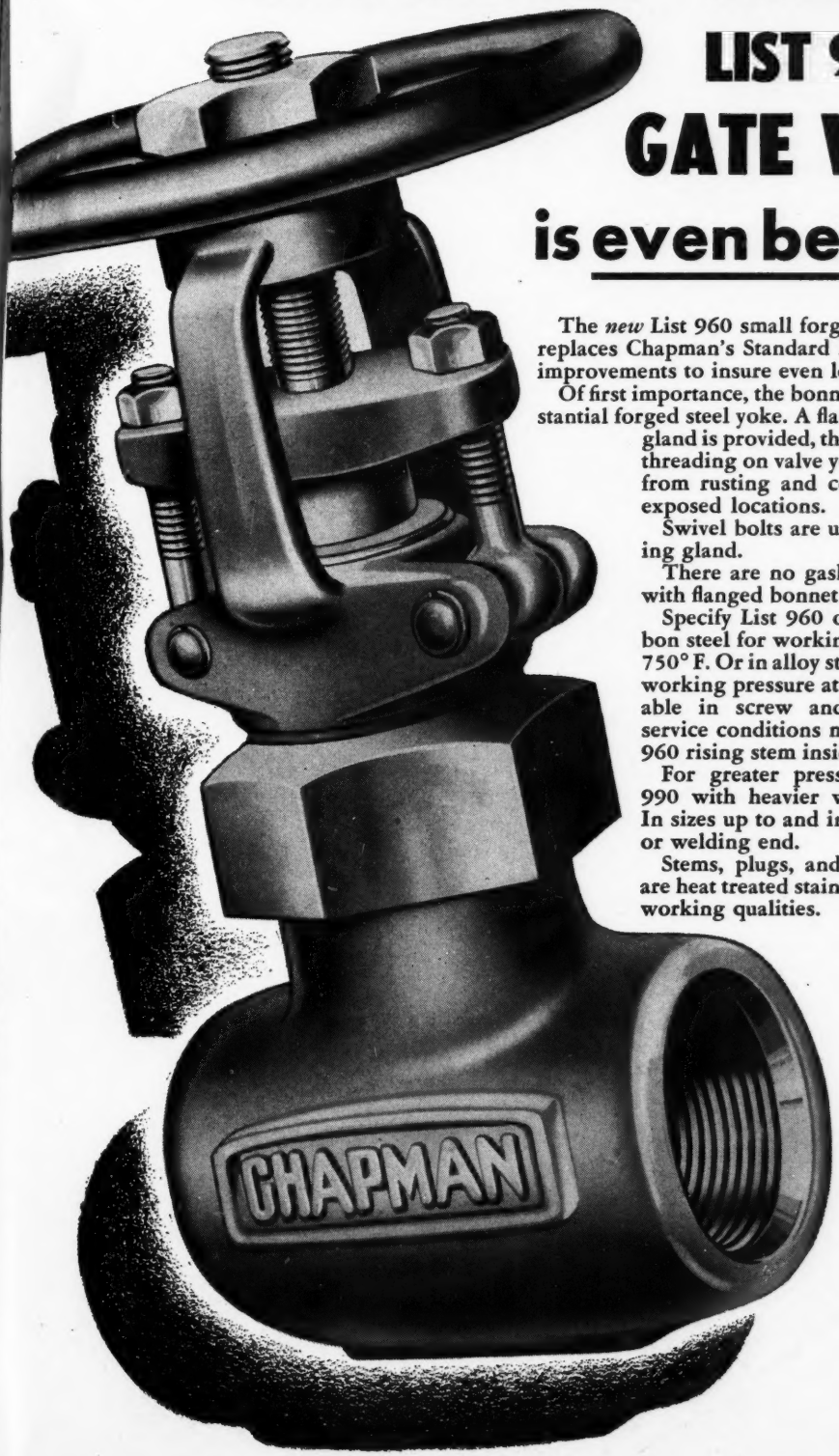
is even better now



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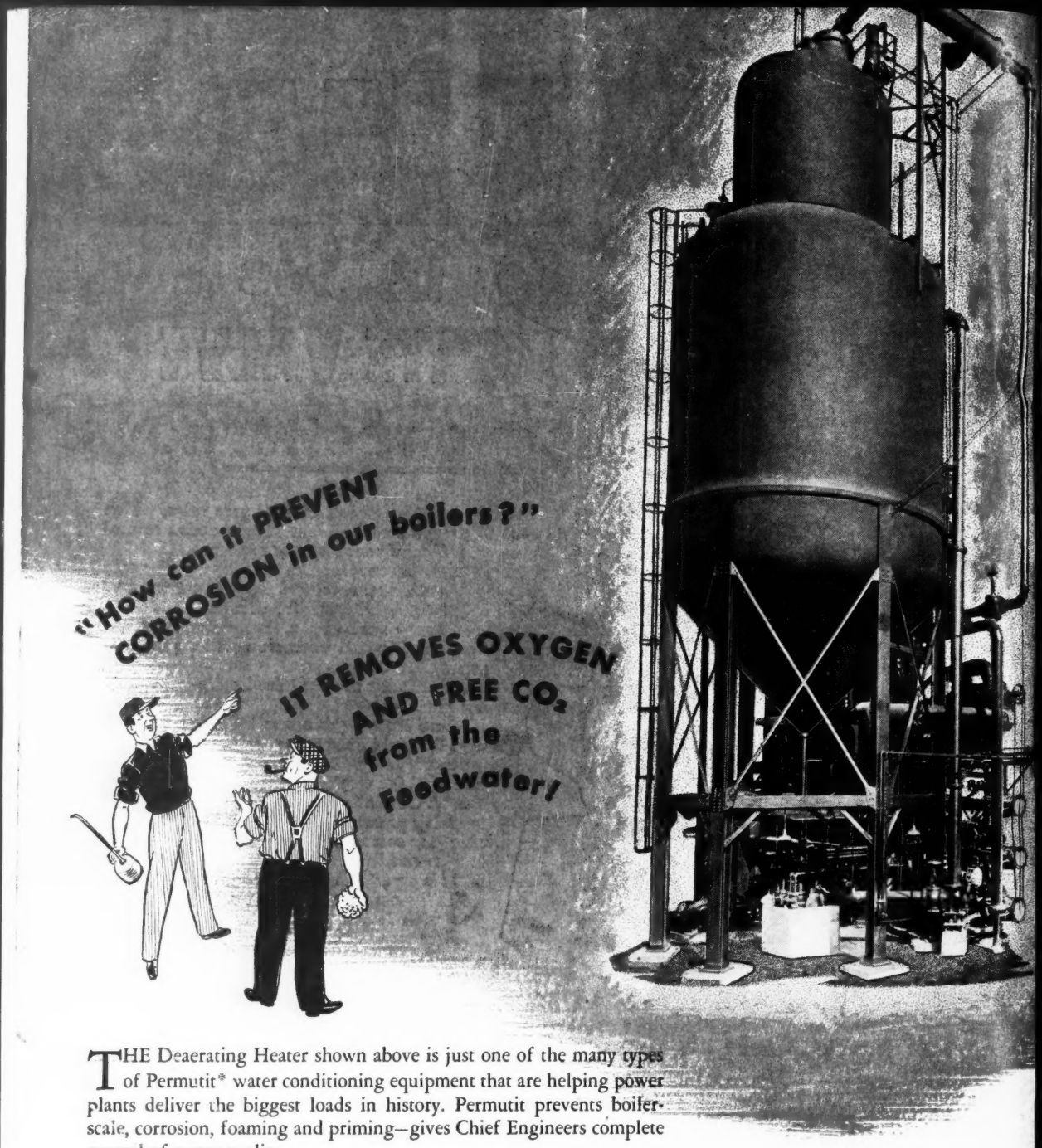
INDIAN ORCHARD, MASS.



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